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Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.

THE GROSS AND NET EARNINGS OF RAILWAYS in the United States for July and the first seven months of 1891 are as follows, according to the *Financial Chronicle*:

	July, (143 roads.)			Jan. 1 to July 31. (125 roads.)		
	1891.	1890.	Inc.	1891.	1890.	Inc.
	$	$	P. c.	$	$	P. c.
Gross earn.	57,847,408	54,200,578	6.73	334,645,674	325,032,331	2.95
Oper. exp..	38,934,074	36,955,263	5.35	232,633,301	229,243,721	1.04
Net earn.	18,913,334	17,245,315	9.67	102,012,373	95,808,610	6.48

The most noticeable feature of the table is the very large increase in operating expenses for the month of July. The returns both for July and the seven months are very irregular. For July 70 roads show decreases in net and 73 roads show increases. Considered in groups the largest increase in net for July is shown by the Northwestern roads, 29.27%, and the smallest by the Eastern and Middle companies, 1.64%. For the 7 months the Southern roads show the heaviest gains in net, 12.57%.

STATISTICS OF CANADIAN RAILWAYS for the year 1890 give the following figures:

	1890	1889	1888
Miles of railway.....	13,256	12,638	6,891
Paid up capital.....	$786,447,810	$760,576,445	$.....
Gross earnings.....	$46,843,825	$42,149,615	$23,561,445
Net earnings.....	$13,830,475	$11,110,580	$.....
No. of passengers....	12,821,262	12,151,051	6,462,948
Tons of freight.....	20,787,408	17,928,626	9,938,585
Train mileage.....	41,849,329	38,819,380	.....

The gross earnings of the Canadian Pacific Ry. show an increase of $2,556,370, and those of the Grand Trunk Ry. an increase of $973,795. The increase in freight carried was larger on the old line than on the new, being 780,235 tons, against 370,563 tons. A decrease of 44,864 in the number of passengers carried by the Grand Trunk led to a falling off of $111,385 in receipts, while the Canadian Pacific gained in this department 228,424 passengers and $398,970. There were 217 lives lost by railway accidents during the year (an increase of 7); 117 persons having been killed by being on the track and 35 (of whom 26 were employees) by falling from cars or engines. There were 7 employees killed and 359 injured while engaged in coupling cars.

THE NEW STEEL HIGHWAY BRIDGE over the Mississippi River at Winona, Minn., will be 2,753.3 ft. long including approaches. The bridge proper will be 1,000 ft. long and will consist of one 200-ft. span, one 360-ft. span and two 250-ft. spans. The Minnesota approach will be 808 ft. long, of which 668 ft. will be iron trestle-work and 140 ft. of masonry and earth fill, and the Wisconsin approach will be 885.3 ft. long of timber trestle-work. From the Minnesota side the grade will rise 4.2 ft. in every 100 ft. to the channel span, which will be level, and then there will be a down grade of 4 ft. in every hundred. The channel span will be 55 ft. above high water mark. The wagon way will be 15 ft. wide, floored with oak, and the sidewalks will be 5 ft. wide, floored with pine. The piers, four in number, will be of masonry on a pile foundation. The entire superstructure will be of iron and steel. The contract has been let to the Chicago Bridge & Iron Works for $94,700. Work is to begin at once.

THE FACILITIES FOR SHIP BUILDING ON THE LAKES make it very desirable to abrogate the treaty with Great Britain, of 1817, restricting the naval forces of ourselves and this nation upon the lakes. This treaty is now entirely one-sided, as England holds the Welland Canal, the only waterway to the lakes, and has a large fleet of light draft vessels of war that could be sent up this channel and into the lakes at short notice. This agreement of 1817 is brought into prominent notice by the late award of a contract for building a torpedo boat to the Iowa Iron Works, of Dubuque, Iowa. There might be a great national advantage in building these boats at points remote from the sea coast and there are yards on the lake shores splendidly equipped for just such work.

THE CAPE COD SHIP CANAL, which is now virtually in the hands of the old company again, through the failure of the Canadian syndicate to deposit $500,000 in the Massachusetts State treasury before Sept. 10, has at its head Col. J. A. LIVERMORE, Vice-President and Manager of the Calumet and Hecla mines, and Mr. QUINCY A. SHAW, a man reputed to be worth $15,000,000. The old company is credited with having expended about $1,100,000 on the work, of which $250,000 was said to have been spent upon the works of Mr. LOCKWOOD, the contractor who built the dredges used, and which works are now run as a separate business establishment. The cost of the canal is then $850,000, and the estimated cost of completion is $4,000,000. The deepest cut on the canal is 60 ft. above the water surface.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a bad collision on the Union Pacific Ry. at Port Neuf, Idaho, Sept. 18. Passenger train No. 2 from Pocatello had orders to sidetrack for No. 1 westbound passenger train at Port Neuf, and when approaching that place, No. 1 was found to be just stopping, having the right of way. The engine driver of No. 2 tried to apply the brakes, but found they would not act, according to the usual but not trustworthy statement of the press dispatches. The 2 engines and 2 mail cars were wrecked. There were 5 persons killed and several injured. It is stated that it was the rule for No. 2 to stop and set the switch, and also that the brakes were in order at Pocatello. A rear collision occurred Sept. 15 near Girard, Cal., on the Southern Pacific Ry. A passenger train was stopped in a tunnel owing to a landslide, and was run into by a following freight train. It is said that the rear brakeman did not go back as he should have done. Only 1 person was killed but several were injured.

A SERIOUS RAILWAY ACCIDENT is reported to have occurred Sept. 22 at Gleiwitz, in Prussian Silesia, on the line between Golaczowy and Wolbrom on the Russian frontier. It was a head collision between two passenger trains, both engines and several cars were wrecked, and the coals from the fireboxes set fire to the wreck. About 11 persons are said to have been killed and 20 injured.

A TRESTLE over the Sangamon River near Springfield, Ill., on the Havana and Springfield branch of the Jacksonville Southeastern Ry., gave way under an accommodation train. There were 3 or 4 men injured.

AN ELEVATED RAILWAY THROUGH THE BLOCKS is proposed for Boston by Dr. H. L. BOWKER. This road would be elevated 15 ft. above the streets and run through the building in a tunnel, or along the second story in a gallery open to the street. He would utilize the space above and below the railway for stores, etc. The novel feature is his proposition that the city build and own the structure and lease it to the operators. Dr. BOWKER estimates the cost of the elevated structure, without equipment, at $250,000 per mile, which is ridiculously low if his plans are correctly stated in the Boston papers.

CRUDE PETROLEUM AS FUEL is being extensively used around Pittsburg, Pa. One of the methods of handling this fuel is that introduced by Mr. JULIAN E. SMITH, Chief Engineer of the Duquesne Traction Co., and consists essentially in feeding under the boiler a mixture of crude oil and dry steam injected from a Reed burner. At the Traction Co.'s works a battery of 5 boilers consumes 30 tons of coal, at $1.45 per ton, every 24 hours, making the cost $43.50 per day. The same boilers use 80 barrels of crude petroleum at 50 cents per barrel, costing $47.20 per day. The saving of labor in using the oil counterbalances the excess in fuel cost. Mr. SMITH says that crude oil is cheaper than natural gas at 25 cents per 1,000 ft.

THE WROUGHT IRON ARCH BRIDGE over Jones Falls, Baltimore, Md., built to connect the city with the new territory recently acquired along its northern boundary, has been completed. The bridge consists of two 25-ft. plate girder spans, two 72-ft. latticed girder spans, and a segmental braced arch span of 150 ft. The plate and latticed girders consist of three lines of girder and the arched span of three ribs, placed 12 ft. apart c. to c. and hinged at the crown and springing lines. The carriageway is 20 ft. wide and there are two footways 10 ft. wide each. The masonry consists of two abutments, six pedestals and two skew-back piers. The contractors for the masonry were Jones & Thorne, of Baltimore, and for the superstructure the King Iron Bridge Co., of Cleveland, O. C. H. LATROBE was the engineer.

FAST HOUSE BUILDING IN CHICAGO is illustrated by progress on the Unity Building. This structure was commenced on July 3, when the first columns were raised, and on Sept. 8, nine weeks afterward, the framework of iron and steel had reached the top and seventeenth story. The fireproofing and terra-cotta facing is now rapidly approaching completion. The Vander Klos Bros., who raised this structure, have contracted to put up the ten-story Mallers Building in six weeks.

THE CLOSING OF THE CREVASSE near the head of Pass a'Loutre, at the mouth of the Mississippi, and mentioned in our issue of Aug. 29, has been ordered. Material is on hand and the work will be commenced about Oct. 1, under Mr. GEORGE Y. WISNER, engineer for the Eads estate.

A CONGO FREE STATE RAILWAY SYNDICATE wants young colored civil engineers for the construction of about 400 miles of railway. At examinations recently held in New York and Philadelphia, GEORGE WELCOME, of Zanesville, O., passed his examination with a grade of 100. He was educated in the schools at Martinsburg, W. Va., and studied railway surveying and engineering at odd hours outside of the schools. Three other young men passed with grades ranging from 72 to 93. They will have six months to prepare for their trip and must sign a contract for four years' service. The pay is to be not less than $800 per annum and expenses.

A HARBOR AT MALMO, SWEDEN, is projected, and the municipal authorities have decided that a prize competition be arranged in order to acquire a plan for the proposed construction. They have fixed three prizes of about $2,220, $1,385 and $830 respectively, to be awarded to those competitors whose completed designs are constructed in conformity with the prospectus already drawn up of the construction of the harbor, and are found by a jury of experts appointed for the purpose to be the most deserving from a technical and practical point of view. The Harbor Board invites entries for this competition. A prospectus in English and containing also a list of the Swedish and foreign members of the jury, may be obtained from the board on payment of 2 shillings.

The New Terminals of the Pennsylvania Railroad at Jersey City.

(WITH INSET)

For over four years the Pennsylvania Railroad Co. has been at work upon the improvement of its terminals at Jersey City, to enable it to handle with safety and dispatch the vast and rapidly growing traffic which concentrates at this point, the eastern terminus of the Pennsylvania Railroad system, which now has a total extent of 7,750 miles. We have from time to time reported the progress of this work. It is now so near completion that we are enabled, through the courtesy of Chief Engineer WM. H. BROWN, to give our readers a full description of these terminals, which will be, on their completion, probably the most important and extensive system of terminals in the country.

With the sole exception of the New York Central & Hudson River R. R., all the lines of railway approaching New York City from the west have their terminals at Jersey City, on the west bank of the North or Hudson River, and transfer their passengers and freight to New York by ferryboats. That this is to be the method of handling the traffic which converges at this point, at least for many years to come, there is much reason to believe. Notwithstanding all the talk of a bridge or tunnel across the North River, and the work which has actually been done in this direction, it is apparent that trains crossing a bridge must climb a long grade to reach an elevation 150 ft. above the river; while to pass trains through a tunnel, a descent of full 90 ft. must be made. Another great advantage of the ferry transfer for both passengers and freight is the facilities it offers for distributing the traffic to points nearest its destination. All the railways terminating on the west bank of the North River, except the Central Railroad of New Jersey, have two lines of passenger ferries reaching different points on the New York shore.

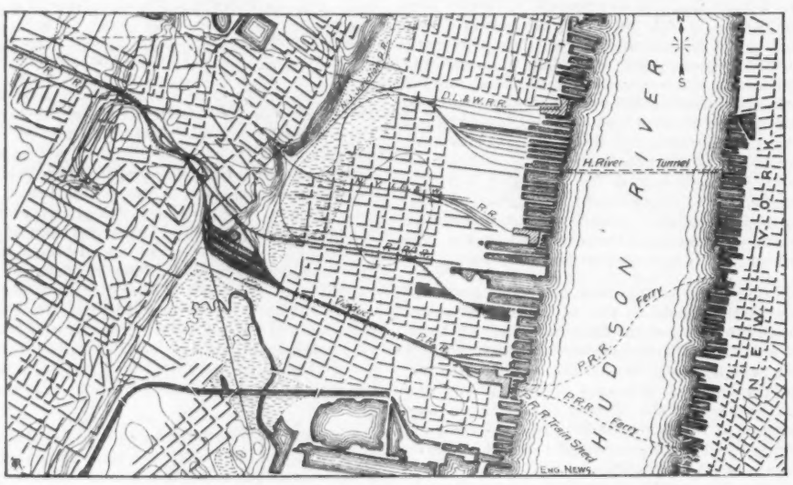


Fig. 1. Map of Part of Jersey City, Showing Terminal Lines of Pennsylvania Railroad.

It is one of the most significant evidences of the probable permanence of the ferry transfer system of crossing the river, and the small faith which the railway managers have in the practicability of handling traffic satisfactorily by either bridge or tunnel, that within the past four years the Delaware, Lackawanna & Western, the Central R. R. of New Jersey and the Pennsylvania companies have each built large and expensive passenger stations in Jersey City and have expended large amounts of money in improving their freight terminals. The Lehigh Valley and the Erie also have expended large sums in improving their terminal facilities. The Pennsylvania's improvements, however, far exceed anything attempted by the other companies.

The topography of Jersey City is by no means favorable to the construction of extensive railway terminals. A mile or so back from the river front a ridge of hard trap rock, the lower extremity of the Palisades, lies parallel with the river. The West Shore, Lackawanna and Erie roads have tunneled this obstruction; but the Pennsylvania, which crosses this ridge farther down, where it is narrower and lower, has made an open cut through the ridge. The old line, which was built about 20 years ago, followed as far as possible a depression across the ridge, and some sharp curves (one of 10° and two of 6°) were necessary. The route of the old line is shown in dotted lines on the map, Fig. 1. To avoid these sharp curves, and also throw the line to one side of the company's property, leaving space for a large yard, a new cut was made straight through the hill, and the sharpest curvature on the line as it leaves Jersey City is now only 3°.

To provide storage for cars and engines, a yard was made by excavating a hill and dumping it into an adjacent marsh, a task which required the handling of about 250,000 yds. of solid trap rock. On the map the contours are drawn, which give some idea of the height of the hill which was dug away. The effect of dumping this rock in the soft marsh was rather peculiar. At Merseles and Pryor streets, in Jersey City, the filling disappeared as fast as it was put in; but the marsh on each side of the right of way rose in proportion, some of it to a height of 18 ft. above the former level. Houses on either side were tilted at an uncomfortable angle, and the company was obliged to purchase a wide strip on each side of the road at exorbitant prices to avoid the payment of still more exorbitant damages. Eventually, however, the filling found bottom; and an embankment was constructed extending east from the Bergen cut as far as Brunswick St., a point about 1 mile from the water front.

THE WALDO AVENUE YARDS.

On the level tract provided by the excavation and filling above referred to, about 20 parallel tracks were laid down, affording storage accommodation for about 240 passenger cars, besides covered tracks with a capacity for 58 Pullmans and wash tracks for 30 passenger cars. A 42-stall roundhouse is located on the north side, and adjacent to it are repair shops, storehouse, buildings for car cleaners, etc.

TERMINALS FOR FREIGHT TRAFFIC.

A large proportion of the coal traffic of the Pennsylvania is carried to the Perth Amboy terminus and put on board vessels there. The oil traffic, too, is diverted from the main line just west of the Waldo Avenue yards, and is carried over the National Docks R. R. to storage tanks at Communipaw. The bulk of the general freight, however, is deflected from the main line, at a point in the Bergen Hill cutting to the Harsimus Cove branch, a double track line crossing Jersey City on an iron viaduct and terminating at the docks and yards on the water front. This viaduct for the freight traffic was built before the one used for the passenger traffic was undertaken. The heavy bridges over which freight cars are run into the car transfer boats at Harsimus Cove were illustrated and described in detail in our issue of Jan. 18, 1890.

A large amount of freight traffic also continues on the main line, and is delivered in the yards north of the passenger trainshed, shown in Fig. 4.

THE PASSENGER TRAIN VIADUCT.

To the inhabitants of Jersey City the most important feature of the Pennsylvania's improvements was the elevation of the passenger tracks across the city to do away with the grade crossings. At the end of the embankment at Brunswick St., a four track viaduct begins and extends to Henderson St., a distance of 1,000 yds. The designs for this viaduct were illustrated over four years ago, in our issue of June 25, 1887. The design adopted (Fig. 3 of our illustrations then published) has two longitudinal plate girders under each track, supported by transverse plate girders, each of which is in turn carried by three columns. The clear height above the street is 13 ft. as a minimum; and as the general surface below is level, there is little variation. The columns are supported on masonry piers, bedded on a 3-ft. layer of concrete, 11 ft. square. Where the foundation soil was unstable, 16 piles were driven for each column foundation; and they were capped with a timber grillage on which the concrete was laid. The penetration of the piles was in some cases as much as 50 ft. Each column is anchored to the masonry by four 2-in. bolts, extending through the pier to the concrete base.

The columns are 18 ins. square, spaced transversely 18 ft. 3 ins. center to center, and the total width of the viaduct over all is 44 ft. The span of the longitudinal girders is not uniform on account of street crossings, etc., and varies from 38 ft. 7 ins. to 60 ft. The web of the cross-girders is 57 ins. × ⅝ in. and of the longitudinal girders 52 ins. × ⅝ in.

A departure has been made in painting the viaduct from the usual practice of the Pennsylvania Railroad, which is to use red oxide of iron paint for iron work, and it has been painted a glossy black with Joseph Dixon's graphite paint. So far this paint appears to be wearing very well.

The viaduct being located directly above the old double track surface road of the company, it was necessary to provide for the traffic during the erection of the viaduct. The two surface trucks were moved far enough to the north to allow the placing of the south half of the viaduct in position. After the south half of the viaduct was completed and the trainshed was in shape to receive trains, traffic was turned over the two elevated tracks. Work on the erection of the north half of the viaduct is now in progress and will probably be completed in a few weeks.

THE TRAINSHED.

The viaduct ends at Henderson St., and from here to the terminus, a distance of 2,475 ft., the ground was filled to a height of 15 to 20 ft. above the original level, which necessitated the bringing in by train of about 350,000 cu. yds. of material from borrow-pits 10 to 20 miles distant. Warren St. and Washington St. are crossed by plate girder deck bridges. The total area filled in is over 11 acres, of which nearly 3½ acres are covered by the trainshed.

From a structural point of view the trainshed is the most important feature of the terminal, and it certainly is its most noticeable feature. Seen from the ferryboats on the river, its colossal arched roof and great glass gable loom up in such proportions as to dwarf into insignificance every building in the vicinity with the exception of the lofty grain elevators.

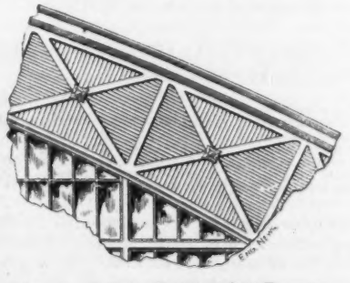


Fig. 2. Exterior Finish of End Trusses.

The main dimensions of the structure are: Length, 652 ft. 6 ins.; width 256 ft.; clear height at center, 86 ft.; height from top of rail to ridge of monitor roof, 110 ft. The whole weight of the structure is carried by 12 pairs of main roof trusses, each with a span of 252 ft. 8 ins. between

centers of end pins. The decision to cover the trainshed by a single arched roof of large span was made after a thorough comparison of the merits of this design and a design in which the roof was divided into three spans and two rows of columns were used through the center of the building. The disadvantages connected with the use of columns in the interior of a trainshed are the danger of a fall of the roof in case derailment or a boiler explosion should wreck one or more columns; the obstruction presented by the columns; the fact that unless very high and expensive columns or braced piers are used the roof is low, affords less air space, has less pitch, and is more liable to leakage. The connection of the central bay of the roof to the two side bays of the design with two rows of columns through the building is also somewhat troublesome to make secure against leakage. These considerations, together with the desire to build a monumental structure, in keeping with the circumstances and traditions of the company, led to the adoption of a design for an arched roof of a single span, greater, so far as we now recall, than the span of any roof truss ever built. The only roof approaching it is the St. Pancras station of the Midland Ry. in London of 243 ft. span, which was built about 25 years ago. On our inset sheet is shown the strain sheet of the main roof trusses, with the details of the work which are of principal engineering interest.

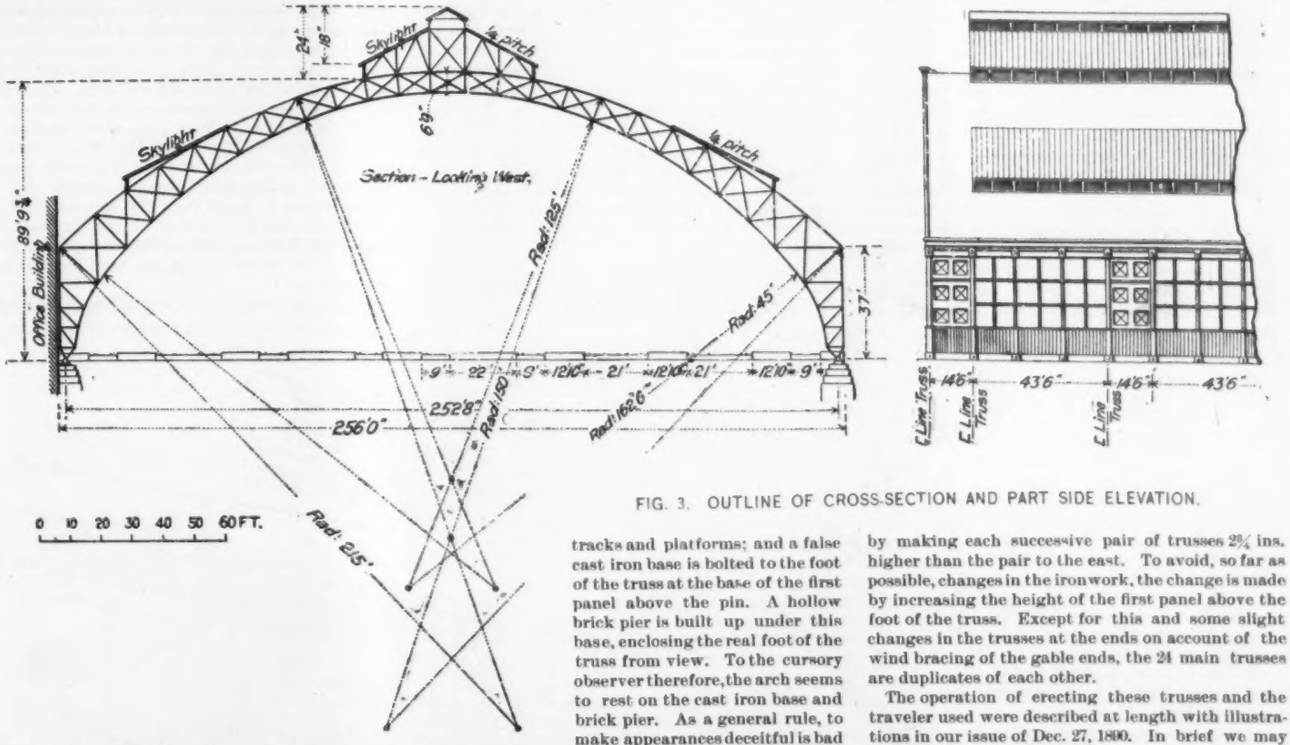


FIG. 3. OUTLINE OF CROSS-SECTION AND PART SIDE ELEVATION.

The main roof trusses.—The whole weight of the structure above the foundation is carried by 24 main roof trusses, of arch form, with riveted joints, and hinged at each foot and at the apex to permit movement with changes of temperature. The centerpin is 5 ins. in diameter and the pins at the foot are 5¼ ins. The assumed loads, given on the strain sheet, are a little over 30 lbs. per sq. ft. for dead load (the weight of the roof and iron work), 17 lbs. per sq. ft. for snow load, and 35 lbs. per sq. ft. of elevation for wind pressure. In calculating maximum strains, the dead load is of course constant; the snow load is figured: first, all over; second, on 12 center panels only, and third, on one side only; the wind is assumed to blow either toward the anchored side or toward the expansion side. The foundation shoes of the north side rest on roller bearings, to permit motion with temperature changes. At first sight it would seem impossible for a compressive strain to be induced in the lower chord: but the strain sheet shows that with the wind blowing against the expansion side, at the maximum assumed force, a compressive strain of 8,000 lbs. may be produced in the lower chord. The lower chord, as shown on the inset sheet, is an I beam weighing 100 lbs. per yd. It runs across the station, beneath the tracks, its top surface being 1 ft. below the base of the rail. To protect it from corrosion and from temperature changes, it is enclosed in a wooden box and the space around it inside the box is filled in solidly with pitch and gravel.

To permit motion at the apex when temperature changes occur, the members above and below the pin at the apex have the rivet holes slotted at the junction and are joined by bolts instead of rivets.

The fact that the two feet of each arched truss are joined at the bottom by a lower chord which sustains a tensile strain from the weight of the roof and iron work alone of 35 tons, is one which will not be suspected by one person in a thousand who examines the station. The lower chord is buried beneath the tracks and platforms; and a false cast iron base is bolted to the foot of the truss at the base of the first panel above the pin. A hollow brick pier is built up under this base, enclosing the real foot of the truss from view. To the cursory observer therefore, the arch seems to rest on the cast iron base and brick pier. As a general rule, to make appearances deceitful is bad taste, architecturally: but in this case there is something to be said for this arrangement. The sides of the arched truss come down to the ground level so nearly vertical that the fact that a horizontal thrust exists there is not suspected. Even an engineer who did not stop to reason that the truss must be hinged at its apex to allow for temperature changes would be deceived. Certainly to have given the structure an appearance of strength which it did not possess, or to have brought the trusses down on their bases at an angle, so that they would have appeared to be in danger of spreading, would have been very bad taste. The arrangement adopted, however, while not exactly what it appears to be, does not seem an objectionable one.

At first sight the permissible loading of 14,000 lbs. per sq. in. for combined dead load and wind or combined dead load and snow, and 18,000 lbs. per sq. in. for combined dead load, wind and snow may seem excessive strains for wrought iron; but it is to be remembered that neither of the assumed maximum loads of 14,000 lbs. for wind or for snow are likely to occur oftener than once in perhaps a score of years. The mathematical chances that these two maximum loads will both occur at the same time are therefore seen to be practically infinitesimal. Even the blizzard of March, 1888, which was probably as great a conjunction of snowfall with wind as has ever been recorded at New York, would by no means have subjected the structure to an excessive load; for the wind pressures probably did not exceed 13 to 20 lbs. per sq. ft. at most, and on the exposed flat surface of the roof the snow would have been swept off by the wind as fast as it fell. As for the strain of 14,000 lbs., due to dead load and wind, or dead load and snow combined, even this will probably come on the structure only at extremely rare intervals, and possibly never. To have a load of snow of even 10 lbs. per sq. ft. on such an elevated and exposed surface as this roof is uncommon in a New York winter, and either wind, sun or rain will be apt to remove a heavy snow fall in a short time. As for wind pressures, the assumed load of 35 lbs. per sq. ft. is 5 lbs. greater than the wind pressure usually assumed in bridge specifications at the present time by the best engineers.

The details of construction of the main trusses are shown for the parts of the greatest interest, the section from the haunch to the foot on our inset sheet. The trainshed tracks are on a grade of 0.4% falling toward the west, to facilitate the starting of heavy trains. The trainshed roof, however, is kept level by making each successive pair of trusses 2¾ ins. higher than the pair to the east. To avoid, so far as possible, changes in the iron work, the change is made by increasing the height of the first panel above the foot of the truss. Except for this and some slight changes in the trusses at the ends on account of the wind bracing of the gable ends, the 24 main trusses are duplicates of each other.

The operation of erecting these trusses and the traveler used were described at length with illustrations in our issue of Dec. 27, 1890. In brief we may say that the trainshed tracks were laid and surfaced and on them were set freight car trucks for carrying the traveler. This was a huge timber frame, with its top made to fit the lower curve of the roof trusses. It was long enough to permit erecting one pair of trusses and the nearest truss of the next pair ahead upon it. After these were erected and braced, the traveler was moved ahead and three more trusses were placed in position. Of course the first step in the erection was to place the lower chord and the feet of the trusses in position. The material was delivered on the ground in sections small enough to be hoisted into place by a single hoisting engine.

Other Ironwork of the Trainshed.—The 24 main trusses form the main members of the roof. The space between each pair is 14 ft. 6 ins., and the space from each pair to the next pair is 43 ft. 6 ins. This space is also divided into 14 ft. 6 in. panels by two light intermediate trusses, which with the main trusses form the rafters for the roof. The intermediate trusses are supported from the main trusses by purlins 3 ft. in depth, running horizontally the length of the building through each panel of the main trusses.

The ironwork of the gables is especially interesting on account of the large surface there exposed to wind pressure, about 12,000 sq. ft. The total pressure upon the gable end at the maximum wind pressure assumed of 35 lbs. per sq. ft. is upward of 200 tons. The ironwork for supporting this heavy strain is shown on our inset sheet. The gable is divided into panels about 10 feet square by light vertical trusses with horizontal bracing. The load from wind press-

ure at the top of these vertical trusses is transmitted to the purlin trusses, which distribute it to the main trusses of the trainshed. The lower end of these vertical trusses is supported by a horizontal truss, 14 ft. 6 in. deep, running across the train shed and carrying the strain from wind pressure to the end main truss at the top of the first section, shown in detail on the inset sheet.

Lighting and Ventilation.—In each panel of the gable is a galvanized iron frame supporting 10 panes of hammered plate glass, each 5 ft. × 22 ins. and ¼ in. thick. This glazing extends over the whole area of the gable inclosed by the inner chord of the end main truss. The end truss itself is finished with a corrugated iron covering, paneled to correspond to the panels of the truss and with false verticals and diagonals on the outer side giving the appearance of a truss from the exterior. Fig. 2 shows two of these finished panels, by which the arrangement of the corrugated iron and the false truss members may be seen.

Besides over 6,000 sq. ft. of glass in each gable, there is a row of windows in the north wall, running the whole length of the building and a row in the south wall for a part of its length. These windows are hung on trunnions so that they can be swung open for ventilation whenever the weather permits. The main sources of light for the trainshed, however, are the skylights in the roof, of which there are four, one on each side of the roof half way between the ridge and the eaves, and one on each side of the roof of the clear story. One-half the total area of the roof is of glass. Fig. 3, which we reprint from our issue of Dec. 27, 1890, shows a cross section of the trainshed and a portion of a side view by which the arrangement of the skylights and the clear story surmounting the main roof will be readily understood. There are four ventilators in the clear story and two in the roof. The details of the upper ventilator in the clear story are shown on the inset sheet.

The main and intermediate trusses running transversely and the purlin trusses running longitudinally divide the roof into panels 14 ft. 6 ins. in length and a little less in width. These panels are filled with the framing for either the glass panes or for the corrugated iron roofing, according to their position. The skylights are all glazed on the Helliwell system. The glass used is rough plate, ¼ in. thick. The elevation of the glass above the train shed platform, from 50 to 100 ft., would make the breakage of a pane and its fall a rather dangerous thing for anyone below. To guard against any accident of this sort, a copper netting of 1½-in. hexagonal mesh is stretched below the whole surface of the skylight.

The very large area of glass and the large air space furnished by the high open roof makes the trainshed very light and free from smoke. As an example of the pains taken to make the interior of the trainshed as light as possible, the wall of the office building which extends for a distance of 160 ft. along the south side of the trainshed is faced with light-colored bricks. At night the trainshed is lit by arc lights suspended about 20 ft. above the station platforms and furnished with current by a dynamo plant operated by the Railroad Co. The whole number of lamps in the trainshed is 64, or one to each 2,600 sq. ft. of area lighted.

Foundations.—The whole trainshed is founded on piles, driven to a good bearing in the silt which underlies the whole water front of Jersey City. The north ends of the main trusses rest on separate piers of masonry 8 ft. 6 ins. square at the base, each of which is supported by 16 piles in rows of four, each row capped by a 12 × 12 in. timber and a tight timber platform laid on top of the caps. The south ends of the main trusses rest on counterforts projecting from the retaining wall, which runs along the south side of the trainshed. A section of the wall and a counterfort is shown on the inset sheet. The three rows of piles to the left are continuous along the whole length of the retaining wall, and six additional piles are added for each counterfort.

The truss shoes at the north end rest on a nest of 8 rollers $2\frac{13}{16}$ ins. in diameter, and a little less than 2 ft. long. The south shoes are secured to the masonry by two 2½ in. bolts.

Specifications, etc.—The trainshed is built throughout of wrought iron. The specifications for its quality and for the workmanship were the same as the standard specification of the Pennsylvania Railroad for the material and workmanship of wrought iron bridges. All the iron work of the building is painted three coats with red oxide of iron paint mixed with linseed oil. The question of what is the best paint to preserve the iron roofs of trainsheds from the corrosive effect of the gases from the locomotive is an important one; but so far the Pennsylvania Railroad engineers have found nothing superior to iron oxide for this purpose.

The credit for the general design of the trainshed is due to Mr. C. C. SCHNEIDER, M. Am. Soc. C. E. The structural details were worked out by the Pencoyd Bridge & Construction Co., who were the contractors for the works. The whole work was done under supervision of the engineering staff of the Pennsylvania Railroad; those to whom special responsibility in connection with the work was entrusted being Chief Engineer WM. H. BROWN, assisted by Mr. WM. A. PRATT at the general offices of the company, and Mr. E. F. BROOKS, Engineer of Maintenance of Way of the United Railroads of New Jersey Division, assisted by Mr. MARTIN L. GARDNER.

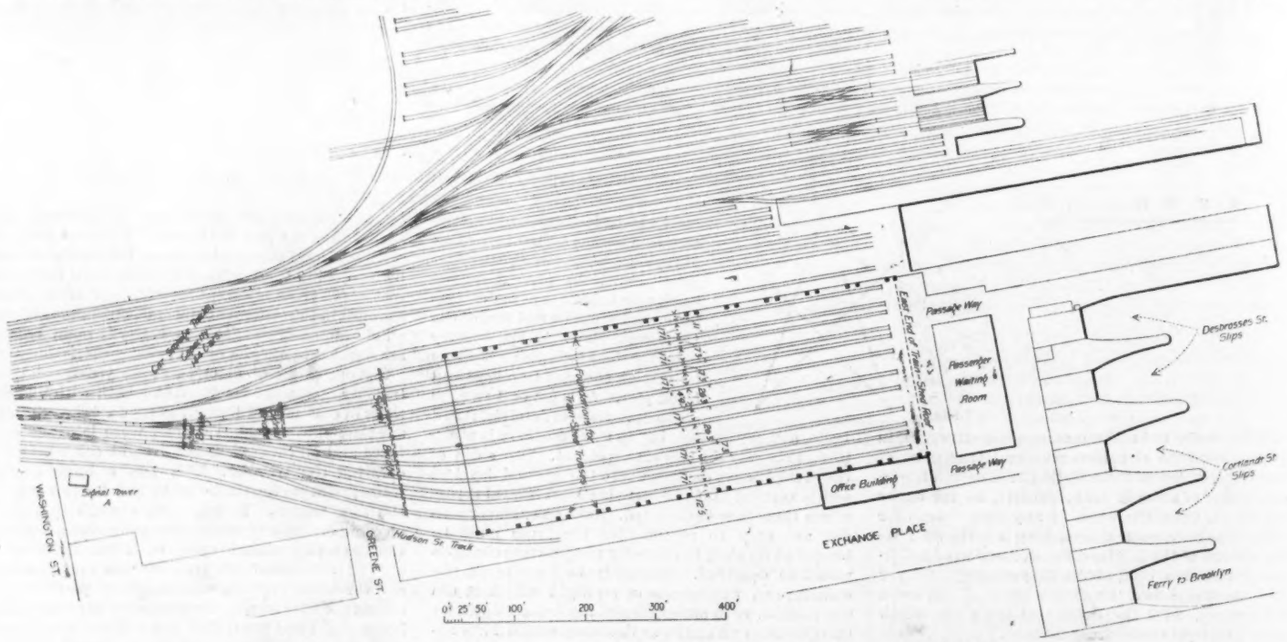


FIG. 4. PLAN OF TRAINSHED, PASSENGER STATION AND TRACK ARRANGEMENT.

ARRANGEMENT OF TRACKS.

As seen by Figs. 3 and 4, twelve tracks run the length of the trainshed, terminating 25 ft. from its east end. The total length of the trainshed is 652 ft. The total standing room for cars on the train shed tracks, measuring from the clearance points, is 8,571 ft. There are three double track lines and six single tracks.

Fig. 4 shows the arrangement of tracks at the terminal. It will be seen that the 12 tracks in the trainshed connect with five tracks in the yard. The arrangement of switches is such that any track in the trainshed can be connected to any one of the five yard tracks; hence any track can be used for either incoming or outgoing trains. This is of especial advantage in case of the blockade of any part of the yard by derailment or other accident, and is also a convenience in handling very heavy traffic.

The junction of the trainshed tracks with the yard tracks is made with a crossing using No. 8 movable point frogs and slip switches. The curves through these slip switches are the sharpest in the yards, being 484 ft. radius. No other yard curves have less than 600 ft. radius. The switches and signals are all operated by the Westinghouse electro-pneumatic interlocking system, erected by the Union Switch & Signal Co. The signals are of the semaphore type, standard on the Pennsylvania, the signals for full speed movements being mounted on posts, while dwarf signals are used for switching movements.

The compressed air for operating the switches and signals is supplied by compressors at the yards on the west side of Jersey City, and is carried through a 2 in. main. A reserve compressor, located at the terminus, can be started at a moment's notice and is run for half an hour on three days in the week. An auxiliary reservoir is located at each switch and signal. The electricity for working the plant is supplied by storage batteries, which are kept charged by a current from the Jersey City electric lighting station.

A novel signaling arrangement has been introduced to notify engineers of incoming trains that a train is standing on the track they are to enter. On the signal bridge 400 ft. west of the trainshed are located the distant signals governing the trainshed tracks, while the home signals are located on a bridge 100 ft. in front. Each trainshed track is connected to form a track circuit, and when a train is on the track the distant signal is thrown automatically to the "caution" position, and remains there until the track is cleared. An engineer, therefore,

who finds the distant signal at caution and the home signal at safety, knows that another train is standing in the trainshed on the track he is to enter, and that he must come in with his train under control.

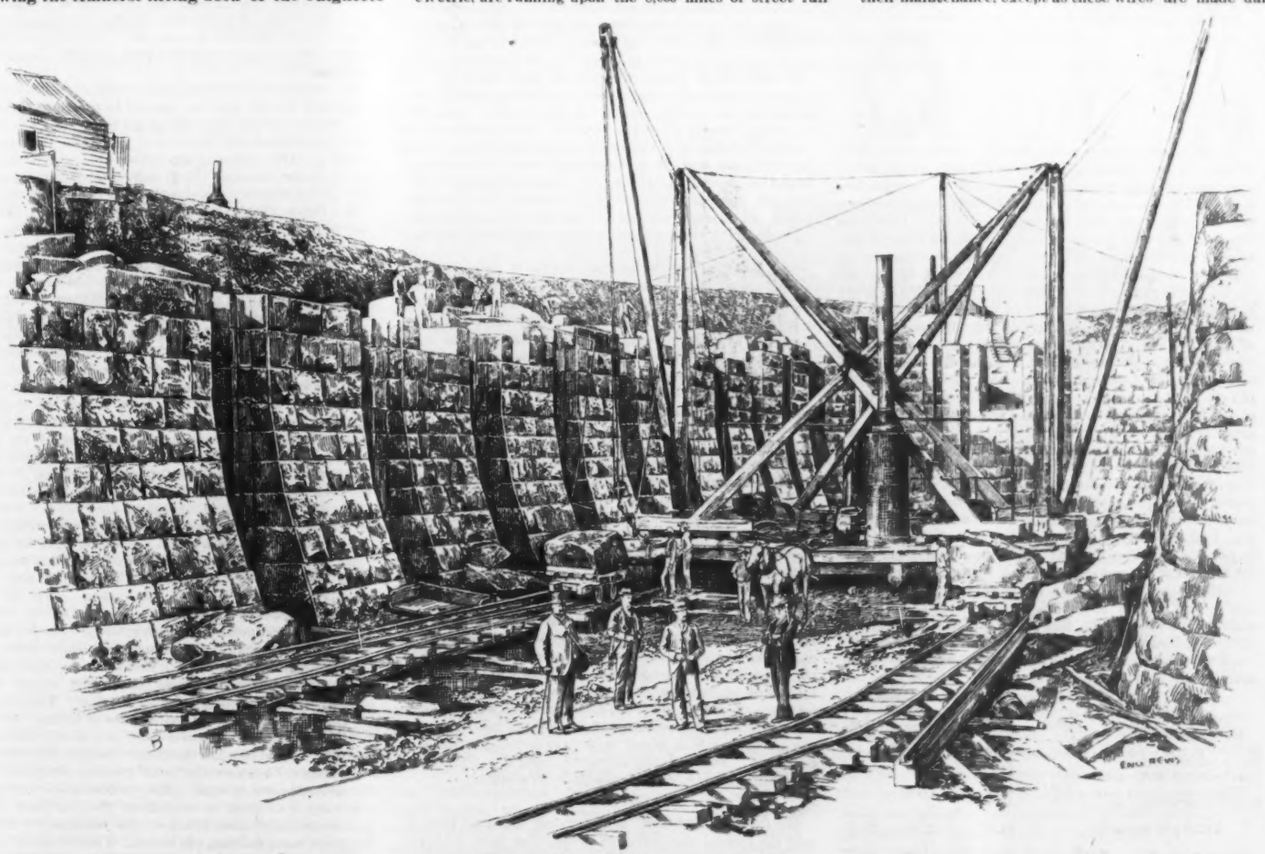
Besides the trainshed tracks there is one track leading down on the south of the trainshed to a terminus at Hudson St., on the water front; and to the north of the trainshed is a yard of 12 tracks, for the storage of passenger cars. To the north of this, on a tract not filled above the old level, are the yards for handling Jersey City local freight and tracks for Adams Express cars.

The arrangement of tracks in the trainshed is in three double tracks and six single tracks, between which are the eight platforms. These are of varying widths, two having the very generous width of 22 ft. and the others being 12 ft. 2 ins. wide. At present wooden platforms are in use; but after the fill on which the tracks are built is thoroughly settled and consolidated, these will be replaced by platforms of granolithic pavement. All the tracks will be ballasted with broken stone to discourage passengers as much as possible from walking across them. The arrangements for supplying water and compressed gas to the cars are unusually complete. On each track there is a gas cock every 50 ft., with hose attached for filling cars, and there is a water cock every 100 ft.

(To be concluded next week.)

The Amherst Dock of the Chignecto Ship-Railway.

The view here presented is from a photograph showing the Amherst lifting dock of the Chignecto ship-railway, as it appeared at the time of the recent suspension of active work. Another view from the opposite direction, not here reproduced, shows this structure to be very nearly completed. All of the machinery connected with this dock is now on the ground, and it is to be regretted that a temporary embarrassment should cause delay in putting to the test of actual use one of the most interesting engineering enterprises of the day.



THE AMHERST LIFTING DOCK, CHIGNECTO SHIP RAILWAY: H. G. C. Ketchum, Chief Engineer.

Electric Motive Power for Street Railways.

The following is an abstract of a paper read by Mr. John N. BECKLEY at the meeting of the Street Railway Association of the State of New York on Sept. 15. Mr. BECKLEY had been appointed a committee on this subject, and the paper constituted his report. We have commented upon some of the points presented in our editorial columns. The abstract of the discussion contains some interesting information:

Out of the needs of modern city and town life grew the horse railway. The development of cities and towns brought with it the necessity for quicker transportation, and, as far as the great cities are concerned, the problem was practically solved by the introduction of cable railways. It was soon found, however, that while cable railways answered the purpose for which they were designed in cities like Chicago and Philadelphia and New York, they would not do in smaller cities, except in isolated cases where vast numbers of people were required to be moved daily over a comparatively short mileage. Five years ago the only street surface railways which were in successful operation anywhere in the United States were horse and cable railways. Within those 5 years more than 4,000 street cars have been electrically equipped, and to-day more than 3,000 miles of track in 300 cities and towns of this country have been constructed, on which these electric cars are run with satisfaction to the people, and, in the main, with profit to the companies operating them.

The development of the street railway has had as much to do with the growth and prosperity of the towns and cities of this country as, or perhaps more than, any other one thing. Nearly 500 cities in the United States have street railway systems in operation. More than 800 corporations are operating street railways in such towns and cities. As many as 30,000 street cars, horse, cable and electric, are running upon the 8,000 miles of street railways in this country. In these cars, and on these tracks, are carried as many as 3,000,000,000 of people yearly, or 50 times the entire population of the United States. When we consider that the number of people carried by all of the steam railways of this country last year is estimated at less than 500,000,000, and that more people are carried on the street surface railway in the city of New York, in a year, than are carried by all the steam railways of the State in the same period, we have some conception of the immense importance to the people of the rapid, efficient and safe service of street cars in the rapidly growing cities and towns. Think for a moment of the daily loss to the people of any city where horse cars are run at from 4 to 6 miles an hour, as compared with the operation in the same city of electric or cable cars, running from 6 to 12 miles an hour.

We who had had to do somewhat with the change of the system of operation from horse to electric power, know that we have now passed beyond the experimental stage, and are beginning to tread upon ground which seems firm under foot. We hear, now and then, fears expressed as to whether the motors are going to last, as to whether the repair bill is not going to wipe out all the profit, and as to whether the great expenditure which has been, and is being made on our railways may not be thrown away, because some new and wonderful principle is to be discovered which will enable our railway companies to operate their roads with commercial success by means of storage batteries. We find in some communities so great a prejudice against overhead wires that railway companies are unable to obtain the necessary franchises and privileges, the granting of which would result in giving those communities the benefits of rapid transit with electricity as motive power. As far as the danger question is concerned, we contend that the only danger to life or limb from the operation of electric cars comes from the possibility of collision with persons or vehicles, and that there is no danger from the electric current itself propelling the car. We contend that the electric pressure used in the propulsion of street cars is below the danger limit. We know that a railway operated by electricity is a pleasant railway to ride upon. The cars are started and stopped on such a railway easily and without jerking.

There is, however, one objection, which is urged with great insistence, especially in the city of New York, to the trolley system, and that is to the trolley wire itself. There is not the slightest danger in putting up or maintaining the trolley and necessary feed wires if the work is done in a proper manner, and if reasonable care is exercised in their maintenance, except as these wires are made dangerous by the telephone, electric light or telegraph wires placed above them.

It must be conceded that poles, however shapely, and wires, however well put up, do not improve the appearance of city streets, but quite the contrary. But experience has shown that except as poles be set and wires strung, electric roads cannot be made a commercial success, and, therefore, without poles and wires electric railways will not be operated. Hence the question presented to the people of a city where the population is not large

enough to sustain a cable railway on a given line is this: Shall we have rapid transit by electric motive power and waive the sentimental objection to the maintenance of a few light wires 18 or 20 ft. above the surface of the street, or shall we have slow transit by horse power with its many disadvantages and disagreeable accompaniments, and be rid of the wires? The question is being answered almost every day in towns and cities in favor of electric rapid transit.

The question is often asked by officials of street railway companies who are contemplating making a change from horse to electric power, what is the cost of operation of an electric railway, as compared with the cost of operating a horse railway? I propose to state some experience which electric railway companies have had upon this subject and to answer the question as well as I can.

You have undoubtedly all seen the census bulletin upon the relative economy of electric, cable and animal motive power for street railways. [This was noted in our issue of May 23, 1891.—ED. ENG. NEWS.]

The company which has had the greatest experience as to these matters is the West End Street Railway Co., of Boston. That company has published a statement showing its earnings and expenses, both with the electric and horse car system, for the months of April, May and June of this year. I ought, perhaps, to state that, as it seems to me, the conditions involved in the consideration of these questions are so diverse in different cities that the only proper basis of comparison of cost of operation is the cost per car mile. It is quite common for the street railway officials to consider this question of the relative cost of operation upon the basis of a percentage of gross receipts. It will be readily seen, however, that this basis of comparison is necessarily misleading and inaccurate. The other basis is not exact, but approaches at least approximately to exactness. The total expense, as shown by this company, for motive power, car repairs, damages, wages of conductors and drivers and all other expenses per mile, and the earnings during the three months mentioned were as follows:

	Expenses.		Earnings.	
	Electric.	Horse.	Electric.	Horse.
	cts.	cts.	cts.	cts.
April	21.75	24.54	34.05	31.77
May	22.36	24.04	33.43	34.22
June	20.37	23.52	42.71	36.85

It will be observed that the earning power of the electric cars is considerably in excess of that of the horse cars, and that the expense per car mile is considerably below. The company states that the electric cars are run on the longer and less remunerative lines. If this be true, the showing made is very greatly in favor of the electric car from a commercial standpoint.

In May last the Rochester Railway Co., of Rochester, N. Y., operated 44 18-ft. vestibule electric cars. The gross receipts from passengers riding on these cars during the month was $37,053, or 23.15 cts. per car mile for a mileage of 159,567 miles. The total expense of operation of these cars for that month was $18,332, thus leaving a net profit of $18,721. The total cost of operation per car mile was 11.4 cts., and the profit per car mile was therefore 12.11, cts. The operating expense was a trifle under 50% of the gross receipts. During the same period the company operated 62 horse cars, all of them without conductors. Most of the horse cars were one-horse or bobtail cars. The total cost of operating the horse cars, without conductors, during this period was about 10 cts. per car mile but the total receipts per car mile were but little above 12 cts. In June the company operated 54 electric cars and 60 horse cars. The electric cars earned each per day $23.60, or 22.77 cts. per car mile, and the total expense of operating them per day was $10.50, or 11.07 cts. per car mile. The cost of operating the horse cars during the same month per car mile was 11.06 cts., and they earned 14.37 cts. per car mile.

The expenses and earnings per car mile were therefore as follows:

	Expenses.		Earnings.	
	May.	June.	May.	June.
Electric:	Cts.	Cts.	Cts.	Cts.
Motive power	2.8	2.40	...	...
Car repairs	.7	1.00	....	....
Conductors and motormen	4.9	5.06	....	....
Other expenses	3.0	2.01	....	....
Total per car mile	11.4	11.07	23.15	22.77
Horse: " "	10.0	11.06	12.00	14.37

We have reached the conclusion also that the cost of maintenance and renewals of electric motors need frighten us no longer. We have had motors in constant service on one of the first electric lines equipped in this country, namely the line extending from Rochester to Charlotte, and these motors seem as efficient and in every way as satisfactory as they did the first month they were operated. We have of course renewed various parts of the motors and we have replaced gears which have worn out, the expense of which has gone into the cost of maintenance. But the motors are still there, doing their work, and likely, with proper care and renewal of parts, to be doing their work 10 and even 20 years, from today. The cost of maintenance and renewal of parts has not been so large as to carry operating expenses up to anywhere near the expense of operating the same number of cars, at the same mileage, by animal or cable power.

Those who propose to substitute electric for horse power will make a great blunder if they attempt to put in cheap construction or material. We have learned that the track upon which it is proposed to operate electric cars should be of girder or T rails, of not less weight than 62 or 52 lbs. per yd. respectively. The weakest place in the track is, of course, at the joint, and no cheap contrivance at that point should on any account be permitted. With girder or T rails it seems to me a useless expense to lay a continuous supplementary wire. The rails should, of course, be well and heavily bonded at the joints with iron, not copper, wire, and cross connection of rails be frequently made. Where tram rail track is used I think a continuous wire should be laid and connected with the bond wire. The overhead wire cannot be too well put up. Cheap devices should never be used because they are cheap. The best and strongest are none too good. In putting up the feed wire and putting in the ground wire return to the generators, do not spare copper. I am convinced that much that we have heard about the inefficiency of generators and motors is due to trying to get too great a quantity of current through too small a quantity of copper. In the power station do not make the units too large. Accidents will happen as long as machinery is run, and an accident to a 500 HP. plant is serious, while you can keep your cars or most of them moving, if one of two or three small engines breaks down. The same rule, of course, holds as to the generators.

One large item of expense of operation is the coal bill. Cut that down at least 40% by erecting condensing engines, although the first cost is, of course, a little more. Locate your power station as near as may be in the center of your system, but above all, if possible, on a stream large enough to furnish all the water you require for the boilers and condensers. City water, where your consumption runs into the millions of gallons, is expensive. It seems to me a mistake to equip a car body of greater length than 18 ft., and I think a 16ft. car is better still. During the hours of the day when travel is heavy, it is easy to pull a trailer, and when traffic is light, you are not then using up your power in hauling around a great lumbering double truck structure practically empty. A great many companies have had trouble with their motors. The chief reason for this trouble has been that their motors have been too light mechanically and too economically built electrically to stand the strain. All the manufacturing companies have learned their lesson, and to-day most of the motors put upon the market are strong enough mechanically and electrically to perform, under proper conditions, the work expected of them.

The managers of the electric roads, if they are to be made successful, must learn that the greater earning power is no excuse for extravagant management, and that the difference between success and failure is often a narrow one. Everything depends upon taking the stitch in time. A loose belt, an imperfect connection, any one of 40 little things, may result in serious damage and consequent financial loss. I do not know of an electric railway anywhere where the overhead single trolley system is used which ought not to be successful. I know of some which have not been. In some cases cheap construction accounts for failure, and in some others careless management or reckless extravagance is the cause of the failure. The scrap heap about an electric car barn or machine shop often tells a significant story. In intelligent supervision and painstaking watchfulness is found one great secret of commercial success in this business, as well as in most others.

Every manager should keep a record of the items which go to make up operating expenses, and those responsible for management should carefully study these statements month by month with a view of lessening the expense of each item. An intelligent and careful examination of the cause of accident to parts of a motor will often be the means of preventing the recurrence of troubles in the future. So far as possible, motormen, as well as conductors, should be made to understand the mechanism of the machines which propel their cars and the function of each part. Thereby they are made ready to act promptly and intelligently in case of trouble with a motor.

DISCUSSION.

Mr. CHAS. A. BENTON, representing the Rae system, said the system was unique in itself. They manufactured a single motor made in three sizes, 15, 30 and 40 HP. The peculiar advantage claimed for this system is that it gives to both axles a traction on the rails, which cannot be got by any other system. He said that the company was the most recent in the field; but he could state that the system had made in some places a respectable record.

Mr. C. C. CURTIS, of the Short Electric Railway Co., said: When this Convention met in Rochester last September, the Short Company made some very strong promises as to the showing that would be made when the road in Rochester was started. What that showing has been you have heard in the report. There has been kept day by day an accurate record of the motor and generator repairs That road started running last November; and giving it 8 months of run, through the winter months—the hardest months in the year—up to the first day of August, the average cost of repairs to generators and motors per car mile was 4 mills. The report just made gives the total repair account, including repairs of the line, generators motors, rails, etc. In Muskegon, Mich., where we have been running about a year and a half, our record shows 2 mills per car mile. We are now prepared to give you the double reduction motor, the single reduction motor, and the no reduction motor. (The Short gearless motor was described in our issue of Sept. 5.—ED.)

Mr. M. K. BOWEN, of the Short Electric Railway Co.: The peculiarities in the construction of our dynamos are in keeping with the peculiarities in the construction of our car motors. The bobbins are separately wound and connected in series. They are exposed to the air around the side, being thoroughly ventilated. The field coils are both series and parallel wound. The shaft is provided with self-oiling bearings, near the commutator, which is extraordinarily large, being about 20 ins. in diameter. Near the commutator is provided a bar, which regulates all thrusts so that there is no danger from displacement.

Mr. GEO. W. MANSFIELD, representing the Thomson-Houston Electric Co., said it is not only a lack of knowledge on the part of the railway officials, but a deep rooted prejudice on the part of the public against the electric system that we have to meet. Then again, I am sorry to say, we did not get the support we should from the builders of the other portions of railway equipment. They did not evince a spirit of accommodation, to see if they could help us in the combination of their manufactures and ours. I am glad to say, however, that matters in this respect have very much improved. We have put our motors under almost every style of car that is built; they have been used with almost every truck that is built, and on almost every kind of road that is built. We have them in the hottest climes, away in Brazil, and in the coldest climes, up in Vancouver, or down in Maine. I believe firmly in the single reduction motor. We have in the neighborhood of 1,200 of them in operation. We are also making experiments with gearless motors, etc.; but I believe that we should pin our faith to that which we know is absolutely satisfactory.

It is said that electric cars have not earned the reputation they should have in regard to handling snow; and that electric roads are still dependent, to a great extent, upon horses and the muscles of men; but that is not entirely so. Our company has endeavored to evolve a plow and a broom sweeper which will demonstrate that electricity is absolutely self-contained in every respect.

Mr. BARR, of the Thomson-Houston Company, said that last year the company got out a snow sweeper which has done excellent work and given good satisfaction. There were some defects in that machine, however, which we have tried to remedy this year. With that in view I early last year made a trip through the country, and personally inspected all of the devices of which I could learn, which were used by street railways, steam railways and cities for sweeping streets. I may say to those of you who are not familiar with the machine we had last year, that it was a brush of rattan set at an angle of 60°, revolving in front of a frame driven by a motor by means of sprocket chains. In a light sugar snow that brush gave good satisfaction; but in a heavy wet snow the brush would clog, and served rather to pack the snow on the rail and make it solid, and, therefore, rendered it impossible for the wheel to get traction. The sprocket chain is always a source of trouble and annoyance. The lines laid down to follow were: *First*, to do away with the rattan broom, and *Second*, to get a positive drive for the cylinder. We have a broom with steel teeth. It is supported from 36-in. 400-lb. wheels, on a Bemis box. The wheels are driven in the same way as with the cars, placing the motor on the axles; we are using single reduction motors for them. The cylinder is set at 45° of the track, extending completely across, and is hung over a rocker shaft. The motor counterbalances the blade of the broom around that shaft, and is geared directly through spur gearing to the flyer. The main feature of the flyer is that is has a series of blades. The best description of it is to refer you to a paddle wheel of a steamer, only of smaller diameter, having the blades cut at the center to allow the spur gearing for the driving. These blades are of steel plate, about ¼-in. thick, and there are 8 of them on each flyer. To the back of the blades are bolted steel brushes; the brushes are made of flat steel wire, cutting edgeways. These brushes are adjustable, and ordinarily their surfaces project from ⅝-in. to 1¼ ins. beyond the blade. The blade does the major part of the work. It breaks the heavy snow, and will actually cut ice.

The steel brush does the rest of the work. It sweeps the road clean, and if allowed to remain long enough in one place will cut the ice as well. The motor driving the broom or brush is independent from the motors driving the car, so that the sweeper can be propelled in a light snow at a speed sufficient to keep it ahead of any of the cars on the line. If you should meet with heavy snow or ice on the track the car can be slowed down, the brush still keeping its normal speed.

Mr. H. W. GRANNIS, representing the Westinghouse

Electric & Manufacturing Co., said: There is one point touched upon by Mr. Beckley in his very interesting paper, attention to which, I think, has given us success in the manufacture of street railway motors. I refer to his reference to the point of mechanical construction in motors. Our first motor was constructed one year ago, and put in operation July 4, 1890, in Pittsburg. It was the old type double reduction motor, all the parts enclosed in cast iron frames. All shafting was run parallel at all times, and the gears kept in perfect alinement. In addition to that, I think we first adopted the old device of enclosing the gears in gear boxes filled with grease. This eliminated the noise and a large part of the wear and tear. That motor is still in operation. I cannot tell the expense for repairs, but they were infinitesimal. Within five or six months succeeding the introduction of our motor we equipped a number of roads with double reduction motors, all in successful operation to-day. In January last we got out another motor, single reduction, having many of the general features of the old double reduction motor. This motor has several improvements over the other. We used a different resistance box. The other worked fairly well, but there was a little trouble. With the new motor we use only galvanized iron wire, and it has given us no trouble in a single instance. It is open and ventilated. We made a slight modification of our controlling device. Formerly it was a wooden shaft with brass contact strips screwed to the shaft. We found this was not quite as durable as we wished, and we are now making them of asbestos and brass. If they do wear at all it makes very little difference, for they are practically indestructible.

In April we commenced to get out a gearless motor, and have been operating that motor since May in Pittsburg. It has exceeded our most sanguine expectations. We have not said much about it for the past three or four months, for the reason that the single reduction motors did better than we expected. They are giving satisfaction wherever they are used. We determined to wait and test the gearless motor thoroughly. This we have done, and to-day we stand before you with two motors to offer, single reduction and gearless. Personally, I express a preference for the gearless. It is simpler than any other. I do not see how it is possible to construct a motor with fewer parts than the gearless. I was interested the other day in reading on the subject of the underground railway in London, where electric traction is used, that the motor for the purpose of moving the train had its armature mounted directly on the axle, which is the plan used by us. In that way we need not have any devices communicating power to the wheels. We do not require any special wheels.

Mr. C. D. SHAIN, of the Edison Electric Co. called attention to that company's double and single reduction motors. Some years ago, when we commenced the manufacture of electric motors, they were from 5 to 10 HP. At the present time many of the roads are using very long and heavy cars, and many gentlemen do not think it necessary to put in more than 15 HP. equipment on such cars. The result is a general disappointment all around, as the motors are too light for that purpose; and then they are equipped with two 15 HP. motors. Where large cars are used, sufficient power must be provided. We shall also present to street car men this winter a snow plow and sweeper combined.

The Department of Transportation Exhibits of the World's Columbian Exposition.

The accompanying illustrations show front and end elevations of the building to be devoted to the exhibit of transportation appliances at the World's Columbian Exposition. From advance proofs of the prospectus and classification furnished us by the Chief of the Department, Mr. WILLARD A. SMITH, we extract the following which is of especial interest to intending exhibitors.

THE BUILDING.

The building for the display of transportation exhibits is located on the western bank of the large lagoon surrounding the beautiful wooded island which occupies nearly the center of the Exposition grounds, and is near the main entrance. It is surmounted by a cupola reaching a height of 165 ft.

FRONT VIEW OF THE TRANSPORTATION BUILDING AT THE WORLD'S COLUMBIAN EXPOSITION. Messrs. Adler & Sullivan, Architects.

END VIEW OF TRANSPORTATION BUILDING, SHOWING ANNEX.

The architects of the building are Messrs. Adler & Sullivan, of Chicago, well known as the architects of the Auditorium. The main entrance will consist of an immense arch, decorated with carvings, bas-reliefs and mural paintings. It will be treated entirely in gold leaf. The roof is in three divisions; the middle one rising much higher than the others and its walls pierced to form a beautiful arcaded clear story.

The main building covers a space of 990 ft. in length by 256 ft. deep; but the main floor includes nearly nine acres of additional space under roof. The total floor space, including the entresol, is nearly 17 acres. A 75-ft. transfer table will traverse the annex along the western line of the main building. Railway tracks will be laid in the annex at right angles to the transfer table. The heaviest locomotives and cars can be run direct from the installation track, which runs alongside the southern end of the building, upon the transfer table which will take them to their proper track inside the building. The length of these tracks is such that an entire train can be shown connected as when in actual use. When installation of heavy exhibits has been completed, the pit of the transfer table will be floored over.

PLAN AND SCOPE OF THE DEPARTMENT.

It is the intent of this department that it shall fully and fairly present the origin, growth and development of the various methods of transportation used in all ages and in all parts of the world. As far as possible the means and appliances of barbarous and semi-civilized tribes will be shown by specimen vehicles, trappings and crafts. Past history will be illustrated by relics of the earlier days. It is hoped that in the interest of historical accuracy and the preservation of important relics, which are now daily passing away, the attention of the Department of Transportation Exhibits may be called, by its friends in all parts of the world, to exhibits of this kind which may and ought to be secured.

The development of water craft from the crudest forms to the modern ocean steamship; of wheeled vehicles from the first inception of the idea of the wheel to their present seeming perfection; and of that greatest of all means of transportation—the railway—will also be further illustrated by accurate models, drawings, plans and designs in cases where the actual apparatus, appliance or machine itself cannot be exhibited. It is the desire of this department to keep the historical feature clearly in view and even to magnify it.

The classification which is presented herewith is intended to be reasonably full and complete, but not to enumerate by name all possible or probable kinds of exhibits. A careful perusal of it will prove suggestive and helpful to intending exhibitors. It may seem to include some things which it is difficult to show in an exhibition of this kind, but the object kept in view is to make so complete an exposition of the methods and means employed in every branch of the business of transportation, that the earnest student of the science may here find everything at his hand, without encountering the difficulties which now beset and environ such study and investigation.

The Railway Exhibit.—A space of over eight acres is devoted to this interest. The plan adopted provides for the best possible utilization of space. Exhibitors will have every opportunity for showing their appliances and devices to the best advantage. As far as possible arrangements should be made by joint agreement for showing everything in its proper place and relations. Locomotive appliances can best be shown on locomotives and the appurtenances and furnishings of cars on cars. Specimens of standard permanent way will afford opportunity for showing track materials, tools and all that appertains thereto in the best possible manner. It is believed that nearly all of the establishments engaged in locomotive, car and bridge-building will be represented. A large number of the leading railways of the world will also make exhibits of their standard roadbed, track and equipment. The opportunity thus offered for joint action is almost unlimited, and by proper placarding where necessary every exhibit may be given proper prominence.

European railway appliances and machinery have never been exhibited on any large scale alongside those used in America. It is hoped that the undoubted influence of this Exposition upon railway development in the future great markets of the world for railway material will be sufficiently appreciated to bring out the desired comparison on a large scale. Abundant and choice space has been designated and reserved for foreign countries; and every possible facility will be afforded foreign exhibitors.

Intramural Transit.—Street railways, surface, underground and elevated, are to be shown very completely in this department. Everything relating to their permanent way and equipment is here included—with the single exception that electric motors must be shown in the Department of Electricity. Cars and other supplies for electric roads belong in this department—a division which, while seeming to be arbitrary, is evidently necessary.

Carriages and Other Vehicles for Common Roads.—A large portion of the floor space of the transportation building proper will be devoted to this display. Included in it, it is hoped to show, with heretofore unequaled completeness, all of the characteristic forms and types of wheeled vehicles, except those used on railways. The classification is to be closely maintained and exhibits of this nature from all countries are to be shown together, so that the most interesting and instructive comparisons may be made. Harness, saddlery and horse trappings of all kinds are here provided for. Other vehicles and conveyances, such as those used on snow, and those employing human muscle as the motive power are also included in this classification.

Bicycles.—This most recent of all road vehicles will receive the attention to which its unequaled popularity and rapidly increasing use entitles it.

Aerial, Pneumatic, Etc.—Transportation through the air and by means of air are yet in a comparatively undeveloped condition. Whatever is worthy in past achievements may here appear; and whatever there is of present success or future promise.

Marine Transportation.—Every known method of transportation on water may be shown in this division. Small craft of all kinds may be exhibited in full size—vessels from the nature of the case must be shown by models. For fuller illustration, drawings, plans and paintings will be shown. Principal attention will be given to the merchant marine. As the government of the United States will make its naval display in connection with its own buildings, the scope of group 86 devoted to vessels of war is somewhat limited. Foreign governments, builders of such vessels throughout the world, and manufacturers of naval supplies, are invited to exhibit, and are assured of every consideration. The separate exhibit of the United States Government will not prevent a representation of its naval history and its present plans by means of models, etc., in this department.

CLASSIFICATION.

DEPARTMENT G. TRANSPORTATION—RAILWAYS, VESSELS, VEHICLES.

Railways: Railway Plant and Equipment.

GROUP 80.—*Class* 499. *Railway Construction and Maintenance.*—Maps, profiles, etc. Grading, track laying and ballasting machinery. Samples of standard permanent way. Systems of drainage. Ballast, culverts, ties, methods of preserving ties. Rails, rail fastenings, frogs, crossings, switches, etc. Cattle guards, railway bridges, trestles, viaducts, with models and drawings. Tunneling, with machinery, models, maps. Methods of constructing, lighting and ventilating tunnels. Turntables and transfer tables. Water supply and machinery and fixtures used by railroads in connection therewith. Track tools. Systems of maintenance. Snow sheds and other protection against snow. General plans, elevations and models of stations and other railroad structures.

Class 500. *Railway Equipment.*—Locomotives for passenger and freight service. Locomotive appliances—headlights, bells, whistles, brake-valves and apparatus, etc. Plans, drawings and photographs of locomotives and locomotive shops

Passenger Cars.—Mail, baggage and express-coaches, drawing-room, parlor, dining, officers' and private cars, etc. Passenger car furnishings and appliances.

Freight Cars.—Box, caboose, stock, horse, milk, refrigerator and other varieties.

Working Cars.—Sweeping, ditching, wrecking, etc.; snow-plows; hand, inspection, push and velocipede cars; bag age barrows and trucks. Freight car appliances of all descriptions. Plans, drawings and photographs of cars and car works.

Class 501. *Railway Operation.—Purchasing Department.*—Methods of purchasing, storing and distributing material and disposition of condemned material. Railway stationery.

Mechanical Department.—Organization. Records, plans and management of shops. Devices for coaling locomotives, etc. Testing laboratories. Machines, apparatus and methods of testing.

General Train Management.—Dispatching, signaling, etc. Speed indicators and recorders. Interlocking switches and signals, block systems, etc. Crossing protection by gates, signals, etc. Wrecking tools and appliances. Plans of yards and methods of storing, cleaning and keeping cars. Car interchange and inspection. Systems of accounting, records, tracers.

Railway Employees.—Methods of testing for color-blindness, etc. Uniforms; organizations, etc. Railway sanitation and surgery, and appliances used therein.

Class 502. *Railway Management.*—Legal department. Treasury and accounting departments. Passenger department—advertising, tickets, ticket cases, punches, baggage checks, etc. Freight department—methods of rate making, soliciting handling, billing, etc.; plans, arrangements, and appliances for handling and housing freight; freight handling machinery; track scales; apparatus for transferring grain from car to car. Traffic associations, their objects, methods, etc.

Class 503. *History and Statistics.*—Exemplified by exhibits of old locomotives, cars, track material and other relics. Railway law and legislation. Railway technical engineering and mechanical associations. Railway literature.

GROUP 81.—STREET CAR AND OTHER SHORT LINE SYSTEMS.

Class 504. *Cable Roads and Cars.*—Construction, equipment, method of operation. Grips and other appliances.

Class 505. *Electric Railway Cars.*—Systems of track construction; equipment and supplies for electric roads. Methods of operation. Appliances and furnishings.

Class 506. *Cars for Street Railways or Tramways.*—Operated by horse power or other means of propulsion not specified. Construction. Equipment and supplies. Methods of operation.

Class 507. *Elevated and Underground Railways.*—Plans, models and maps showing systems of construction. Systems of operation and maintenance.

GROUP 82.—MISCELLANEOUS AND SPECIAL RAILWAYS.

Class 508.—Mountain Railways. Spirals, switchbacks, rack rails and all systems for climbing inclines. Ship railways. Multiple speed railways (moving platforms and sidewalks). Gravity roads. Sliding railways. Plans, profiles, drawings, photographs and models.

GROUP 83.—VEHICLES AND METHODS OF TRANSPORTATION ON COMMON ROADS.

Class 509.—Hand-barrows, wheel-barrows, trunk and barrel trucks.

Class 510.—Carts, trucks, drays, farm wagons, garden truck wagons.

Class 511.—Freight wagons and other heavy wagons for special purposes, beer wagons, express wagons, wagons for moving heavy objects, as timbers, stone, iron, etc.; sprinkling carts. (For fire engines and ladder trucks see Group 70.)

Class 512.—Large wagons for pleasure parties, picnic parties and excursions, "breaks," "barges," wagonettes, etc.

Class 513.—Omnibuses, herdics, cabs, hansoms, etc.

Class 514.—Drags, Concord leather spring coaches, wagons for mail, express and passenger service.

Class 515.—Pleasure carriages, coaches, Victorias, Broughams, dog carts, etc.

Class 516.—Light pleasure carriages, buggies, phaetons, etc., trotting wagons and sulkies.

Class 517.—Sleighs, sleds, cutters, toboggans, snow shoes, etc.

Class 518.—Steam and electric carriages, and all vehicles for carrying passengers on common roads operated by other than horse power.

Class 519.—Ambulances for special purposes—for the sick and injured. Hearses.

Class 520.—Bicycles, tricycles and the appurtenances.

Class 521.—Rolling chairs for invalids and others, baby carriages, etc.

Class 522.—Wagon and carriage wood-work, hardware and fittings.

Class 523.—Harness, saddlery, robes, whips and accessories of the stable.

GROUP 84.—AERIAL, PNEUMATIC AND OTHER FORMS OF TRANSPORTATION.

Class 524.—Transportation of letters and parcels in pneumatic tubes.

Class 525.—Shop fittings for the transportation of parcels and money.

Class 526.—Balloon transportation and captive balloons for observation and experiment.

Class 527.—Passenger elevators and lifts.

GROUP 85.—VESSELS, BOATS—MARINE, LAKE AND RIVER TRANSPORTATION.

Class 528.—Sailing vessels and boats. Sailing vessels used in commerce: pilot boats, fishing vessels, sailing yachts, ice boats, ship's boats, pleasure boats, canoes, and small boats of all kinds propelled by sails, oars or paddles: models, designs, drawings, descriptions, specifications, photographs, paintings, etc.

Class 529.—Steamships and all vessels propelled by steam, electricity or motive power other than sails, oars or paddles. Ocean steamships; coasting, lake and river steamers. Tank steamers, cable steamers, steam pilot vessels, steam fishing vessels; steam fire, police and patrol boats; steam schooners, towboats, steam yachts, steam launches, naphtha launches, vessels designed for jet propulsion or to be propelled by any unusual device. Models, designs, etc.

Class 530.—Vessels, boats and floating structures for special purposes. Docks and other receptacles for vessels, and structures used for docking or hauling out vessels or boats. Transports for carrying railway trains or cars; barges, canal boats, coal rafts and coal boxes; water boats, dredges, floating derricks, elevators, etc., dry docks and marine railways. Models, designs, drawings, etc.

Class 531.—Marine Mechanical Appliances.—(For nautical instruments see group 151) (for marine engines, boilers, pumps, condensers and appurtenances see group 69). Devices for propulsion; devices for obtaining forced draft; steam capstans; windlasses; deck winches; appliances to facilitate loading and discharging cargoes; steering apparatus; marine electric motors, electric indicators, engine room and bridge signal systems, and apparatus; boat lowering and detaching apparatus; speed indicators and speed registers; appliances for laying, picking up and repairing ocean telegraph cables, etc.

Class 532.—Construction, Outfit, Equipment and Repair of Vessels.—Methods, articles, fittings or appurtenances. Methods and materials used; special designs for hull or fittings; plates, cellulose, woodite, etc.; water tight compartments; rudders, masts and spars; rigging, anchors, chains and cables, hawsers, ropes, cordage, wire rope, etc.; sails, blocks and tackles, oars, etc.

Class 533.—Methods of lighting, heating, ventilation and refrigeration of ships.

Class 534.—Protection of Life and Property and Communication at Sea.—Harbors, lighthouses, buoys and similar aids to navigation, and all pertaining thereto; life-saving service, boats, rafts, etc. Precautions against fire aboard ship, and devices for extinguishing it. Storm and coast signals; marine signals, models, plans, samples, etc.

Class 535.—Wrecking Apparatus—Submarine armor and divers' appliances; pontoons for raising vessels; equipment for wrecking steamers, etc.

Class 536.—Miscellaneous.—Trophies of yacht and boat clubs; relics of merchant marine and river transportation; relics of arctic and other explorations; seamen's associations; uniforms and designations of rank; flags and ensigns of merchant marine, yacht clubs, etc.; designs, maps, charts, etc.

GROUP 86.—NAVAL WARFARE AND COAST DEFENDER.

Class 537.—Armored Vessels.—Battle ships, rams, cruisers, coast defense ships, models, designs, drawings, descriptions, specifications, photographs, paintings, etc.

Class 538.—Unarmored Vessels.—Frigates, sloops and gun vessels; cruisers; dispatch vessels and tenders; torpedo vessels and torpedo boats; submarine boats; public vessels for special service; revenue vessels, surveying vessels, etc., man-of-war boats, etc., models, designs, etc.

Class 539.—Ships and boats of war of barbarous and semi-civilized nations. Models, drawings, photographs, etc.

Class 540.—Models and relics of famous ships of war; relics of naval battles, etc.

Class 541.—Training ships; naval schools; naval institutes; naval reserve, etc.

Class 542.—Guns and Armor, and adjuncts and appliances of naval warfare. (See also Group 113.) Guns, armor; torpedoes; small arms for naval use; projectiles and ammunition; fuses; submarine mines; methods, devices, fittings or appliances designed for use in naval warfare and coast defense.

INFORMATION FOR EXHIBITORS.

Space.—Blank applications for space and copies of the rules and regulations of the Exposition may be had by writing to or calling at the office of the Director-General. There is no charge for space.

Power.—A limited amount of power (electric or compressed air) will be furnished free of charge.

Transportation Rates.—The principal railway and steamship lines of the United States have agreed to charge the regular full rate on all exhibits going to the Exposition, but to return the same, if unsold, free of charge. Some lines have agreed to charge half rate each way.

Awards.—The following extract from the adopted report of the Committee on Awards of the World's Columbian Exposition fully explains the subject:

> The committee recommend that awards shall be granted upon specific points of excellence or advancement, formulated in words by a board of judges or examiners, who shall be competent experts; and the evidence of these awards shall be parchment certificates, accompanied by bronze medals.
>
> "The awards of these boards of judges or examiners will thus constitute an enduring and historical record of development and progress as represented by the exhibits in question; the parchment certificate will, by sufficient terms of identification, evidence the award, and the bronze medal will serve to the exhibitor as an enduring memento of his success. Those exhibits which in the opinion of the juries and examiners do not possess sufficient excellence or intrinsic development to warrant awards, will simply be scheduled in the general catalogue of the Exposition. . . . It is recommended that there should be but one class or kind of medal; that they should be made of bronze; that they should be works of art and selected from competitive tests by the Committee on Fine Arts of the Commission, or the Joint Committees on Fine Arts of the Commission and the Local Directory, if that should seem more desirable. . . . The awards and the appointment of all judges and examiners for the Exposition, by the express terms of the sixth section of the act of Congress, approved April 25, 1890, fall within the exclusive jurisdiction of the Commission."

Holding Power of Drift Bolts and Spikes.

The question of the holding power or resistance of drift bolts is one of considerable importance in connection with various engineering works, but there is little published information that is generally accessible. Some elaborate and complete experiments were made by the U. S. Engineering Corps as far back as 1874–1877, the records of which have been buried out of sight in the voluminous official reports. The tables in the report on these tests are very extensive, but we have summarized and rearranged them so as to show more clearly their indications. General summaries of the results of these and some other experiments, with the information deduced therefrom, were given in ENGINEERING NEWS, Feb. 28, 1891.

These government experiments were made with iron drift bolts and spikes under the direction of Major G. WEITZEL, upon the St. Mary's Falls canal

improvement, and at the harbor of refuge on Lake Huron, during the seasons of 1874, '75, '76, and '77, by Assistant Engineers NOBLE and GILBERT. The results are given in a report by Gen. O. M. POE, U. S. A. The apparatus used consisted of a pair of 7-ton hydraulic jacks, with suitable frame and connections, and a 10-ton Duckham hydraulic weighing machine, from which the strains were read directly. The timber used was generally white pine. Norway pine and hemlock were also used to a limited extent, as shown in the tables. The timber is generally mentioned as "moist." To estimate differences in quality of timber, both round and square bolts were drawn from the same stick. Two classes of blunt points were used. "Long blunt points" were tapered back for a distance of 1½ to 2 ins. and reduced to a round section on square as well as round bolts, with a diameter less than that of the holes into which they were driven. These were pointed hot. "Short blunt points" were reduced in size at an angle of about 45° by cold hammering, the point of the square bolt remaining square, with rounded corners; the intention being more to remove all cutting edges from the point than to reduce it much in size or to change the square sections to round.

Table No. 1 gives the results of experiments showing the effect of time on the holding resistance of 1-in. round and 1-in. square iron drift bolts with long blunt points, driven in various sizes of holes bored through sticks of white pine timber. It shows a small but unimportant gain, with occasional loss as the effect of time. There is a wide difference in the recorded results of individual tests, as in those of the succeeding tables, but the summary shows a net gain of about 300 lbs. per test on bolts that were left in the stick for 7 months before they were drawn.

This table shows an average resistance of 1-in. bolts of 10,535 to 10,840 lbs., but tests mentioned by a correspondent in our issue of Nov. 29, 1890 (p. 488), gave resistances of 37,500 and 30,000 lbs. for 1-in. round bolts driven 1 ft. into holes 1 in. and 15/16-in. respectively. The timber in that case was good white oak, about half seasoned. On the other hand, tests made at the University of Illinois gave the resistance of a 1-in. round rod in a 13/16-in. hole perpendicular to the grain, as 6,000 lbs. per lin. ft. in pine and 15,000 lbs. in oak. Experiments made at the East River Bridge gave resistances of 12,000 and 15,000 lbs. per lin. ft. for a 1-in. round rod in holes 15/16-in. and 1 1/16-in. diameter respectively. The timber in this case was Georgia pine. Both of these latter sets of experiments are referred to in our issue of Feb. 28, 1891.

Tables Nos. 2 and 3 show the resistances of different sizes and kinds of bolts in holes of various sizes, with the averages obtained therefrom.

In considering the results given in these tables reference should be made to the article in ENGINEERING NEWS, Feb. 28, 1891, already referred to. The general averages may be summarized as follows, and the results of the averages taken in this way show little practical difference between the resistances of round and square bolts:

	Holding power of—bolts. Round. Lbs.	Square. Lbs.
Average of all plain 1-in. bolts	8,224	8,200
Excess in favor of round	24	.....
Average of all plain bolts	7,805	8,110
Excess in favor of square	.....	305
Average of all bolts	8,383	8,598
Excess in favor of square	.....	215

Table No. 4 shows the resistance of wedge-pointed ship spikes driven in white pine, with the edges with and across the grain. In the first four sets of experiments the spikes were drawn back. In the last two the spikes were driven through 3-in. plank until the heads were flush with the surface, and the heads were pulled through at once. The planks used were much splintered by the spikes when the points broke through the lower surface in driving. These experiments formed a part of the government tests already referred to.

TABLE NO. 4.—HOLDING POWER OF SHIP SPIKES.

Spike.	Depth driven.	Holding Power. Edge with grain.	Edge across grain.	Increase due to edge with grain.
	Ins.	Lbs.	Lbs.	Lbs.
7 × 9/16 × 9/16	3	1,617	1,317	300
" " "	4	1,625	1,342	283
8 × 9/16 × 7/8	5	2,180	1,720	460
10 × 1/2 × 1/2	7	3,650	3,000	650
7 × 9/16 × 9/16		1,521 lbs.		
10 × 1/2 × 1/2		1,708 "		

Tabie No. 5 gives the resistance of railway spikes in ordinary wooden ties, and is summarized from the tables of the adhesion of spikes given in a report by Mr. P. H. DUDLEY, C. E., and printed in Bulletin No. 1 of the Forestry Division, U. S. Department of Agriculture, 1887.

TABLE NO. 1.—EFFECT OF TIME ON THE HOLDING POWER OF DRIFT BOLTS.

Holes.	AVERAGE RESISTANCE. Just after driving.	Seven months after driving.	Gain from time.	Loss from time.
Round bolts.				
Ins.	Lbs.	Lbs.	Lbs.	Lbs.
11/16	10,691	10,850	759	.....
11/16	10,050	10,275	225	.....
13/16	9,983	9,675	.....	308
13/16	10,275	10,075	.....	200
13/16	10,600	10,541	.....	59
13/16	8,775	9,983	1,208	.....
Square bolts.				
13/16	12,000	11,050	.....	950
13/16	9,975	9,866	.....	109
13/16	10,116	12,975	2,859	.....
14/16	11,466	10,483	.....	983
14/16	11,408	12,650	1,242	.....
14/16	13,841	12,475	.....	1,366
15/16	10,536	10,791	225	.....
15/16	8,341	10,066	1,725	.....
Aver'ge	10,535	10,840	305	.....
Total gain and loss			8,243	3,975
Net gain			4,268	.....
Net gain per test			300	.....

TABLE NO. 2.—HOLDING POWER OF ROUND BOLTS IN HOLES OF DIFFERENT DIAMETER.

Round bolts.	7/8-in.	15/16-in.	1 1/16-in.	1 1/8-in.	1 3/16-in.	1 1/4-in.	1 5/16-in.	1 3/8-in.	Average.	Timber.	Remarks.
¾-in.	5,875	5,250	6,875	5,125	.....	.....	.....	.....	5,781	Wh. pine	Driven 12 ins. Drawn back.
1-in	.....	.....	.....	10,042	10,612	10,204	9,500	.....	10,089	"	" " " "
"	.....	.....	.....	.....	10,830	8,625	.....	.....	9,727	N'rw'y p.	" " " "
"	.....	.....	.....	.....	6,750	.....	.....	.....	6,750	"	" " " "
"	.....	.....	.....	.....	6,167	6,497	.....	.....	6,332	Wh. pine	" " " through.
" headed (h'ds 1¼ ins. diam.).	.....	.....	.....	.....	7,083	.....	.....	.....	7,083	"	Drawn through.
" " (" 1⅛ " ").	.....	.....	.....	.....	8,933	8,084	.....	.....	8,508	"	" "
" ragged moderately.	.....	.....	.....	.....	9,683	.....	.....	.....	9,683	"	" "
" " "	.....	.....	.....	.....	6,750	.....	.....	.....	6,750	"	" back.
" " excessively.	.....	.....	.....	.....	3,850	.....	.....	.....	3,850	"	" through.
" " "	.....	.....	.....	.....	5,267	.....	.....	.....	5,267	"	" back.
" p'nted (round p'nt).	.....	.....	.....	.....	.....	10,125	9,375	.....	9,750	"	Bored 10 ins. Driven 12 ins.
" " " ").	.....	.....	.....	.....	.....	.....	.....	.....	9,222	"	Driven 10 ins., without boring.
" " (wedge point), edge with grain	.....	.....	.....	.....	.....	.....	.....	.....	6,833	"	" " " "
" " (" " " across "	.....	.....	.....	.....	.....	.....	.....	.....	7,838	"	" " " "
" threaded (8 threads to in.).	.....	.....	.....	.....	.....	15,125	14,833	14,250	14,736	"	Screwed through 12 ins. and drawn back.
" " (12 " ").	.....	.....	.....	.....	.....	15,250	18,000	13,833	15,694	"	
1 1/16 in.	.....	.....	.....	.....	.....	.....	8,187	7,083	7,635	"	Driven 12 ins. Drawn back.
"	.....	.....	.....	.....	.....	.....	8,875	.....	8,875	Hemlock	" " " "
"	.....	.....	.....	.....	.....	.....	7,250	.....	7,250	"	" " " " through.

TABLE NO. 3.—HOLDING POWER OF SQUARE BOLTS IN HOLES OF DIFFERENT DIAMETER.

Square bolts.	7/8-in.	15/16-in.	1 1/16-in.	1 1/8-in.	1 3/16-in.	Average of square.	Average of round.	Timber.	Remarks.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		
15/16-in.	8,125	7,375	.....	.....	.....	7,750	.....	W. pine	Driven 12 ins. Drawn back.
1-in.	.....	.....	9,557	10 193	8,355	9,369	10,089	"	" "
"	.....	.....	.....	6,508	5,350	5,929	6,332	"	" drawn through.
"	.....	.....	.....	.....	7,375	7,375	.....	Hemlock.	" "
"	.....	.....	.....	.....	10,125	10,125	.....	"	" drawn back.
" headed. (heads 1¼ ins. sq.)				11,308	.....	11,308	.....	"	Drawn through.
" (ragged moderately.)				7,633	.....	7,633	6,750	.....	" back.
" do. do.				5,133	.....	5,133	9,683	.....	" through.
" pointed (q're point)			10,000	11,375	.....	10,687	9,750	.....	Bored 10 ins.; driven 12 ins.
" " (" ")				.....	.....	10,160	9,222	.....	Driven 10 ins.; without boring.
" " (w'dge point)			edge with grain.			8,322	6,833	.....	" "
" " (" ")			edge across grain.			9,375	7,838	.....	" "

TABLE NO. 5.—HOLDING POWER OF RAILWAY SPIKES.

	Length of spike. Ins.	Length in tie. Ins.	Pounds to start spike. Chestnut.	Y. Pine.	W. Cedar.	W. Oak.	Hemlock.
Good spike in solid wood	5 to 5.9	4.4 to 4.9	3,244	3,198	.....	4,330	3,485
Spike drawn and redriven in same hole	5.5	4.5	1,496	.....	.....	.....	.....
Old corroded spike drawn	5.3 to 5.5	4.6 to 5.0	*2,583	.....	.....	4,227	.....
Old spike redriven in old hole	5.5	4.5	1,700	.....	.....	3,360	.....
½-in. hole bored full length of spike	5.5 to 5.75	4.6 to 4.9	.....	2,650	1,460	6,505	3,300
⅝-in. " " " "	5.5	4.7	.....	3,010	.....	.....	.....
⅝-in. " " " "	5.5	4.7	.....	3,250	1,755	.....	.....
½-in. lag screw	.....	3.0	.....	2,850	.....	.....	.....
⅝-in. "	.....	.....	.....	.....	.....	.....	†3,580
Sharp pointed spike	5.5	4 9	.....	.....	2,305	.....	†4,290

* Corroded.
† Diam. at screw ½-in.: 3,580 lbs. in ⅝-in. hole, 4,290 lbs. in ½-in hole.

Experiments with Liquid Fuel.

The use of liquid fuel, or petroleum, instead of coal for generating steam in the boilers of marine engines has been revived among steam engineers by the recent experiments with it on the English steamship *Erros* and the Italian steamships *Castelfedando* and the *Ancona*. But the most successful use of petroleum as fuel in marine boilers has been on the English torpedo boat *Sunderland*. This boat has a displacement of 86 tons, and is 137 ft. in length. The boiler is of the ordinary locomotive type, with web bottom, the furnace front being arranged to receive the oil burners, which are 31 in number. The liquid fuel used is dumped from the double bottom (the tanks which hold the oil) and discharged into a small cylindrical tank, where it is subjected to an air pressure of 35 lbs. per sq. in., and whence it flows direct to the burners.

In the fireroom is an air compressor which discharges into cylindrical air tanks near the vessel's side, forming a group of four. The working pressure of air in these tanks is 40 lbs. per sq. in., and it is conveyed here for the purpose of disintegrating the oil as it leaves the burners. Each jet of oil gives a clear, bright flame, about 6½ ft. long and 9 in. in diameter, if burning alone. When the jets are combined in the furnace there is a bright mass of fire about 2 ft. from the furnace mouth to the tube plate. This flame entirely fills this portion of the furnace, and gives forth neither smoke, smell nor sparks, so that neither soot nor dust is deposited in the tubes, and no sweeping is required. Special precautions are taken to avoid the bad effects of high temperature and rapid changes of temperature, and it is stated that these are so efficient that, though the boiler has been repeatedly forced very hard, there has not been a sign of leakage about the boiler.

Assistant Engineer WILLIAM H. ALLDERDICE, on duty in the Naval Bureau of Intelligence, has given liquid fuel a close study, and has carefully investigated all of the reports on experiments with it. From these reports it would seem that the question of danger has been practically surmounted, and that the question of the use of liquid fuel is reduced to that of cost. At the same time, the dangers from fire or explosion have not been entirely eliminated by experiments, and, although the cost of the liquid fuel is admitted to be greater than that of coal, this greater cost is partly offset by a reduction in the number of firemen, and in the expense also of their provisions and quarters. Lieutenant ALLDERDICE quotes from a paper read before the Shipmasters' Society of London, on the use of liquid fuel, which in substance is: In England and America it is known as "residuum." It is the residue of

crude petroleum, when all the volatile or lighter oils are distilled from it. It is perfectly non-inflammable, until heated to 350°, and, consequently, quite safe to use and carry in large quantities. It has no smell, as it does not emit gas until it reaches the required heat. It does not deteriorate by being stored in tanks exposed to the air, nor does it evaporate perceptibly. It is not detrimental to metal tanks, the inside skin of the vessel, nor any of the ordinary receptacles. The expert says: "One serious question of to-day is: How are we to fuel our men-of-war at sea during a blockade? It has been demonstrated that the successful transfer of coal at sea cannot be depended upon; besides, the modern men-of-war are not constructed for rapid coaling. With oil fuel the case is different; the large tank steamers could always fuel the fleet, even in heavy weather. To fuel a vessel of war in bad weather, the tank steamer could be made fast to the former by running a hawser from one to the other; a hose could be made fast along the line of the hawser, and the fuel be pumped into the ship's bottom at any rate desired."

The Italian Government is continuing its experiments with oil fuel on vessels of war, and, while no definite information is afforded as to technical details, it would seem that satisfactory results have been obtained. The Peruvian government has directed that the gunboat *Santa Rosa* be altered for burning oil in its furnaces. The British Admiralty are considering the advisability of burning oil fuel, but have not, as yet, decided what kind to use. The Navy Department will have some definite results on the use of oil fuel within the next few months, as it is the intention to have exhaustive experiments made with it by the Board of Engineer experts at the New York Navy Yard.

The special advantages claimed for liquid fuel are: It has greater efficiency than coal, weight for weight; the manner of stowing it in the double or cellular bottoms gives increased stability to the vessel, and increase of available space for other purposes, now occupied for the stowing of coal; it will require a less number of fire-room force than with coal fuel, and there is no ashes nor refuse from oil fuel. In manœuvring under steam, it may often be desirable to stop suddenly while at full speed and not to use the engines for some time. With coal fires this would be difficult, as they would have to be banked, and while lying dormant would become dirty; but with liquid fuel as many burners as necessary may be shut off when the engines are stopped, only enough being kept in operation to prevent the steam pressure from falling. When full power would be required it could be had at once with furnaces and everything clean and in good shape.

THE ELECTRIC WELDING CO., LIMITED, has been incorporated in London with a capital of £460,000, or $2,300,000. Among the directors are Sir GEORGE BARCLAY BRUCE, Past Prest. Inst. C. E., E. ASHMEAD BARTLETT, M. P., and JOSEPH KINCAID, M. I. C. E. The consulting engineer is Sir FREDERICK BRAMWELL, Past Prest. Inst. C. E.

A NEW MAGAZINE RIFLE, which fires 9 shots in 2 seconds, was tested at Fort Sheridan, Chicago, on Sept. 10. It is invented by Dr. H. A. PITCHER, of Nielsville, Wis. The rifle is made automatic by utilizing the gas produced by the combustion of the first cartridge fired. This gas escaped into a chamber and acts on a piston connected with a spiral spring, the action of which removes the empty cartridge, reloads and cocks the gun. The magazine holds 9 cartridges and the inventor claims that these can be discharged in 2 seconds. Owing to some alleged injury to the mechanism the best record made at the test was 8 shots in 5 seconds.

THE TOKIO-YOKOHAMA RY., JAPAN, was officially opened to traffic on July 1, 1889. It connects the above cities with Kioto, Osaka and Kobo and the total line is 376 miles long. In the mainland of Japan lying east of the Biwa Lake there are now 902 miles of railway open to traffic. The one gap in the line connecting Tokio with Naoetsu, on the northwest coast, is at the Usui Pass, and this is now being filled by a 5 mile section of steep grade which is to be operated by the rack-rail system. Within the present year Awomori, on the most northern point of the main island of Japan, will have rail communication with Tokio, the distance being 529 miles. Only one 90 mile section is still incomplete. The opening of the line will make Hakodate the chief port of entry for passengers and freight from the west and swift steamers are to be put on the line connecting with Awomori, 60 miles away. A number of other railways are projected and some under construction, in Japan.

PERSONALS.

Mr. JOHN B. ECHOLS has been appointed General Manager of the Ohio Valley R. R.

Mr. THOMAS S. BRENNAN has been appointed Street Cleaning Commissioner of New York City, vice Mr. HANS S. BEATTIE.

Mr. AUGUST HUMBERT, civil and mining engineer, and consulting engineer for the dam and water power plant at Folsom, Cal., died Sept. 6.

Mr. WILLIAM C. STROUD, partner of the firm of Burnham, Williams & Co. (Baldwin Locomotive Works), Philadelphia, Pa., died Sept. 21, aged 53.

Mr. A. S. DOUGLAS has been appointed Superintendent of Motive Power and Rolling Stock of the Texas & Pacific Ry., vice Mr. W. H. ELLIOTT, resigned.

Mr. J. N. VAN WAGNER, Roadmaster of the Hudson River Division of the New York Central & Hudson River R. R., has been appointed Superintendent of Bridges of that division.

Mr. A. M. MOZIER, Superintendent of Transportation of the New York, Lake Erie & Western R. R. and Chicago & Eastern R. R., has been appointed General Superintendent, vice Mr. F. E. MERRILL, resigned.

Mr. A. T. SHOEMAKER, for some time connected with the Troy Steel & Iron Co. and the Illinois Steel Co., has opened an office at 146 Broadway, New York, and the Rookery Building, Chicago, supplying railway supplies and equipment.

Mr. E. SHERMAN GOULD, consulting engineer for Messrs. Runkle, Smith & Co., New York, contractors of the Vento Water-Works, Havana, Cuba, has returned to New York for a short vacation, and to make arrangements for the completion of the above works next season.

Mr. J. B. FULLER has been appointed Division Engineer Maintenance of Way, Norfolk & Western R. R., with headquarters at Roanoke, Va., vice Mr. G. M. THOMPSON, resigned. Mr. J. CAPLES has been appointed Assistant Engineer, Radford Division, with headquarters at Radford, Va., vice Mr. J. B. FULLER, promoted.

Mr. RUDOLPH HERING, M. Am. Soc. C. E., sanitary engineer, has returned from an extensive trip in Europe, during which he visited and studied nearly all of the greater sewage disposal works in England and on the Continent. Among these were Berlin, with the largest irrigation farm in the world; Frankfort, Wiesbaden, Essen, etc., and the precipitation works of London, which treat 110,000,000 galls. of sewage per day.

Gen. ROBERT ST. GEORGE DYRENFORTH, in charge of the government rain-making experiments, was born in Chicago in 1844. He served during the civil war and retired with the rank of colonel. He graduated as M. E. at the Polytechnic School at Carlsruhe, and received the degree of Ph. D. at the University of Heidelberg. He returned to this country in 1869, read law, and was admitted to the bar, but in 1871 he entered the Patent Office at Washington, was afterward Examiner-in-Chief of the Patent Office under President HAYES, and under President ARTHUR he was Assistant Commissioner of Patents, and was finally appointed by President Cleveland to act as Commissioner of Patents upon the resignation of Mr. B. BUTTERWORTH.

NEW PUBLICATIONS.

—*Wooden Trestle Bridges*, A treatise on, according to the present practice on American railroads. By WOLCOTT C. FOSTER, New York, 1891. John Wiley & Sons, 11½ × 9 ins. 155 pp., many diagrams and tables of quantities, etc. Price $5.00.

The author is to be commended for his industry and patience in gathering the data used in this volume, and for giving to the engineering profession the best practical work ever issued upon this subject. Mr. FOSTER commences with an illustrated glossary of all the terms used in trestle building, and then in a short introductory chapter he shows how much of this class of structure there is still upon American railways. Mr. THEODORE COOPER, in a paper on "American Railway Bridges," read before the American Society of Civil Engineers, says that there are about 2,400 miles of single track railway trestle in the United States, and while much of this is of a temporary character, at least 300 miles of it will be maintained in wood. One railway trestle on the borders of Lake Pontchartrain, in Louisiana, is 22 miles long. At an average price of $6 per lineal foot, the 2,400 miles would represent an invested capital of $76,032,000. In an interesting table in this chapter the author compares the cost of embankment and trestle work, including rails, ties, ballast, guard rails, etc. The heights above the ground range from 5 ft. to 45 ft. and the sections compared are 100 ft. long. For a 14 ft. roadbed an embankment is cheaper than pile and framed trestles up to about 20 ft. in height. At 40 ft. the embankment costs $2,193, pile trestle, $1,132 and framed trestle $1,322 per 100 ft. This is taking the embankment at 20 cts. per yard and timber at $35.

Chapter II. is upon "pile bents," giving the varieties of timbers used, detailing and illustrating the practice in various sections. Pile splices, shoes, rings, penetration under the hammer and contractor's cost of driving are included in this part of the work. Pile-drivers form the matter for a separate chapter, including floating, stationary and car pile-drivers. All of these are illustrated, with dimensions. Cram's steam pile-driver is also described. Chapter IV. discusses framed bents, crib and grillage foundations, and the methods and appliances for framing and erecting trestles. The floor systems are treated of in Chapter V., as used on various railways. The bracing and framing of high trestles and trestles on curves, the iron details, holding value of drift bolts and dowels, etc., are very fully explained. The eighth chapter relates to connection with embankments, bridge guards, and some of the miscellaneous features of trestle building. Chapter IX. takes up the subject of field engineering and the erection of trestle work, and includes in this a description and illustration of the tools used. The next chapter treats of the preservation of joints and standard specifications at very considerable length, and teems with useful hints to the engineer. Forms of proposals for building, estimates of approximate quantities, bills of materials, etc., are here given.

Part II. of this work gives the standard designs for various forms of trestles as adapted on many of our railway systems. In each case these drawings are made to scale with all dimensions also plainly figured. Each set of plans is accompanied by a table giving the full dimensions of the various timbers and the sizes of the iron details. There are nearly 40 sets of these standards including about every variety of high and low trestle and those designed for special application. The result is a collection of plans that, taken together with the detailed description, tables, etc., compiled and prepared by Mr. FOSTER, make a very valuable addition to the practical literature of the engineer. The matter throughout is plainly and clearly treated, as is fitting to the subject and the material used is obtained directly from the engineers of the roads using the types described. Unfortunately, the publishers have made the work much too expensive; and by heavy sized paper, wide margins, and unwarranted space for the engravings have produced a book more like an art publication than a technical treatise.

—*Stones for Building and Decoration*. By George P. Merrill, Curator of Geology in the U. S. National Museum; John Wiley & Sons, publishers, New York, 1891; 8vo. cloth, 453 pp. and illustrations. Price $5.

The position of the author as curator of the geological collection in the National Museum, at Washington, D. C. has made him very familiar with the characteristics of American stone for building and decorative purposes, and he here puts this knowledge at the service of the public. Part I. is devoted to the geographical distribution of building stone in the United States; to their physical and chemical properties and to their classification. The Quincy granite quarry, opened in 1825 for the purpose of obtaining stone for the Bunker Hill Monument, says Mr. Merrill, was the first quarry of this nature in the United States of any importance. Previous to that, and as early as 1650, stone houses had been built about Boston, but the material was usually secured from surface bowlders. Granite quarries of lesser importance than those at Quincy were opened in 1792 at Haddam Neck, Conn., and the material there obtained, which was a gneiss rather than a granite, was used for curbing and paving in New York, Boston, Albany, Baltimore, etc. The great Maine granite quarries were opened in 1836-7.

The first marble quarries in New England were opened in New Milford, Conn., about 1800, and those of Dover, N. Y., and Rutland, Vt., were opened about 1830. But Vermont marble was quarried and used to some extent as early as 1785, the product being sold for fire jambs chimney backs, hearths and lintels. Micaceous gneiss was used for the foundations of houses in Philadelphia as early as 1682, and in 1785 whole houses were built of it, and some are still standing. Connecticut sandstone was quarried and used as early as 1665. The earliest systematically worked slate quarries are said to have been those at West Bangor, Pa., which date back to 1835, though a slate quarry was opened in 1812 near Slateford, Pa. Mr. Merrill says, however, that the use of slate for gravel stones as long ago as 1721 would indicate an earlier use of this material for other purposes, and he finds it stated that slate quarried at Lancaster, Mass., was quite extensively employed for roofing purposes in Boston in 1750-53. The concluding portions of this first part relate to the characteristics, structural and chemical, of the various building stones, and their geographical distribution in the United States.

Part II. treats of the various building and ornamental stones in detail, their quarries, etc. This is really the bulky and the most important part of the work, as it takes up each stone separately, gives its composition and use, location of chief quarries, and in many cases the method of working, with sections of the formation. Part III. is first devoted to a description of the methods of quarrying and dressing stone, with illustrations of the tools used. Interesting chapters follow on the weathering of various kinds of stone, the selection and testing of building stone, the comparative durability of stone, and the protecting and preservation of stone. An appendix gives the crushing strength, weight, absorption and chemical composition of building stone; prices and cost of cutting, a list of some of the more important stone

structures in the United States, and finally a glossary of terms. The entire work is a valuable and timely one, and we predict for it a wide circulation, especially among engineers.

—*Poor's Directory of Railway Officials and Manual of American Street Railways.* New York. Sixth edition, 1891; Poor's Manual of Railroads. Cloth; 6x9 ins; pp. 428. Price $2.

The present edition of this publication contains several new features in addition to its usual standard lists of railway officials and its statements of street railways, duplicated from Poor's Manual of Railroads. The most important of these are: The indexed list of railway officials; the tables showing the location of general and transfer offices and locomotive and car repair shops, and a series of statements relative to the various railway lines projected for construction. There is also a list of foreign railways which was formerly printed in the Manual of Railroads. The various tables and lists appear to be quite complete.

—*Report of the Water-Works Investigating Committee of the East End Improvement Association, of Cincinnati, O.* Pamph., pp., 11. July, 1891.

This report advises the construction of a large settling basin, from which water would flow to a storage basin. Water would be pumped from the Ohio River to the settling basin and repumped from the storage reservoir to the present reservoirs and to stand-pipes. Mr. GEORGE HORNUNG has been employed by the association as Consulting Engineer and his conclusions are included in the report.

—*Report of the City Engineer of Toronto, Canada,* 1890. Large 8vo, 146 pp., many folding maps and plans.

A very complete exhibit by Mr. W. T. JENNINGS, the City Engineer, of the present status and plans for the future of the engineering work of Toronto. The notable features of this report are—that it is much more complete in itself than such reports usually are in its subject matter, detailed information and scale plans of completed and intended work. It commences with a clear but brief description of the city itself and with the laws controlling the appointment of the City Engineer and his assistants. Following this come the detailed information of city work, accompanied by the plans referred to. Regarding the much discussed Esplanade improvement, the report says that no special progress has been made toward a final settlement of the questions relating to the rearrangement of the water front, with its railways, riparian owners, lessees, etc. The Don Valley improvement is entangled with the Esplanade problem, but about $575,000 has been expended in straightening and improving this river and valley, between the Grand Trunk railway bridge and Winchester street, and this portion is about in shape for the use of the railways and the completion of highways. The trunk sewer project, the subject of many reports, is still under discussion. Mr. JENNINGS, in a special report, favors the plans proposed by Messrs. Hering and Gray, with the exception that he would not complete the system until the population had reached 360,000. The estimated cost of the whole work is $1,632,518, on a system providing for a population of 500,000, occupying an area of 9,133 acres. The City Engineer estimates that for the present population of 300,000 only the low-level and Rosedale Ravine sewers need be built, at an estimated cost of $393,833. An excellent colored map of Toronto accompanies this report of Mr. JENNINGS.

An interesting lengthy table is given of the cost of building various sizes of sewers by days labor, in 1890, with the cost per lineal foot, and the average depth below the street surface. Mr. JENNINGS advocates this system of work as costing little or any more than contract labor and serving to keep contracts within reasonable bounds. A somewhat similar detailed statement follows for wooden sidewalks; and later is a comparative table of costs for different classes of street pavements. A good index of matter and plans adds to the value of the report.

—*Manchester Ship Canal,* Report on, by THOMAS MONRO, M. I. C. E., Government Engineer, Ottawa, 1891. Pamphlet, 17 pp., with fine map.

A condensed report made by order of the Canadian Privy Council of this interesting work. It contains a most excellent map of the route from Manchester to Liverpool.

—*The Business of Travel.* By W. FRASER RAE. Thomas Cook & Son, publishers, London and New York, 1891. 8vo, 318 pp. For distribution and not for sale.

This is a 50 years' record of the progress of the enterprise started by THOMAS COOK in 1841 for extending and vastly increasing the conveniences of travel through the world. Commencing with the old-fashioned methods, the author shows how, in 1841, the original THOMAS COOK organized an excursion by rail between Leicester and Loughborough for members of a temperance society. This was the first excursion by rail, and from it arose organized pleasure trips between the same points, and, in 1851, excursions to and from the great London Exhibition of that year. In 1855 he did the same thing for the Paris Exhibition, and in the following year advertised his first "Grand circular tour on the Continent." Without going into the detail of the marvelous growth of this enterprise, now literally covering the world, the following statistics may be given: The firm of Thomas Cook & Son issue steamer tickets available over 1,479,220 miles of water travel; the combinations which can be made by Cook's tickets represent a total of 170,000,000 miles; they issue tickets over 344,739 of the 360,495 miles of railways in operation in the world. During 1890 they issued 3,262,159 tickets. To conduct their business the same year a salaried staff of 1,714 assistants was required, and, in addition, 978 were employed in Egypt and Palestine during the winter months.

TRADE PUBLICATIONS.

—*Contractors' Supplies.* Illustrated Catalogue of Ripley & Bronson, St. Louis, Mo. Large 8vo. 415 pp.

This is one of the most complete illustrated catalogues of supplies, for boiler makers and engine builders, water and gas works contractors, steam and gas fitters, mills, factories, etc., that has ever come to this office. It is filled with illustrations, gives dimensions and trade prices and such discounts as are possible in a catalogue of this description. It is an exceedingly handy book to have about, and is very handsomely issued.

Isaac B. Potts Pipe Fitting Co., Columbus, O. Paper, 3¾ × 6½ ins., pp. 20. Illustrated catalogue and price list

—*Electric Railway Material.*—The Electrical Supply Co., Chicago. Catalogue No. 31; 1891-92. Paper, 9¼ x 6 ins.; pp. 640; copiously illustrated.

This company is prepared to provide almost all material needed by electric railways, and the catalogue gives prices, weights and other particulars, with illustrations, of different kinds of poles, wire, cables, brackets, insulators, trolleys, electric switches, gear wheels, bells, lamps, indicators, meters, etc. Track drills and other tools are supplied, as well as the specialties of the Short Electric Railway Co. The Burton electric heater for cars is described. About fifteen pages are devoted to tables of electrical information, details of wires, and notes on the construction and operation of electric railways. An index adds to the value of the catalogue.

—*Philadelphia Corliss Engines.* Philadelphia Engineering Works. Paper, 9 × 6 ins., pp. 9.

—*Holly System of Steam Heating,* for cities and villages, through pipes laid in the public streets. American District Steam Co., Lockport, N. Y. Paper, 6 × 8 ins., pp. 32.

This pamphlet described the system, invented by Mr. BIRDSALL HOLLY, of steam distribution for heating and power by street mains. This is the system used by the New York Steam Co., and a list is given of about thirty places where the system is in use.

—*National Car and Locomotive Builder Supplement.* New York, 1891. John N. Reynolds, Publisher; paper, pp. 120.

This is an advertising annual issued for free distribution, and containing directories of manufacturers of cars, car wheels, car axles, car springs, locomotives and steel rails, also directories of the street railways of the United States and Canada, and of the railways and tramways of South America. We have compared the latter with Poor's Directory, just out, and find quite a difference between the two. Poor gives 34 railways in the Argentine Republic, while the "Supplement" gives 22. The latter, however, gives 79 railways in Brazil, while Poor describes only 65. Each authority gives 20 in Chili, and Poor has 6 more in Cuba than has the "Supplement."

—*Grooved-Rail Sections.*—"Phœnix" Actien-Gesellschaft für Bergbau und Hüttenbetrieb, Laar bei Ruhrort, Germany. Cloth, 12 x 21½ ins., plates 33.

This interesting and well got up catalogue consists mainly of engraved plates of full sized and dimensioned sections of the Phœnix Company's grooved girder rails for steel railways, showing the sections of splice bars, and having a table of the quantity of material for each system. There are also plates of frogs and switches for this kind of track, which is said to be in use in Germany, England and other European countries, and also in America and Australia. Drawings and descriptions of some of these rails were given in ENGINEERING NEWS, May 12, 1888.

—*The Cincinnati Corrugating Co.* Piqua, O., 1890. 6 × 9 ins., pp. 43.

The principal uses of corrugated iron are for roofs and sides for buildings, for street awnings, arches for fireproof floors, ceilings, shutters and lathing. All these uses are fully described in the above catalogue. As the life of corrugated iron exposed to the weather depends upon its protection by paint, it is of interest to note that the company still sticks to the ordinary metallic paint mixed with linseed oil as the protection which it applies to corrugated sheets before shipping, unless black sheets (unpainted) are especially ordered. Whether they have ever tried any of the asphaltum paints, we do not know. Perhaps the expense would be prohibitory.

Among the different goods turned out is a sheet made to imitate wooden clapboards for use as siding, which we should think would make a better looking building than the ordinary corrugated iron put on with the ridges vertical. The roofing made by this company has a specially deep corrugation at the edge, so that a single lap is sufficient to make a tight joint between sheets. In proof of their claim that an iron roof is more durable than shingles, tin or slate, the company submits letters reporting iron roofs which have done service for forty to fifty years. Of course they were kept painted.

SOCIETY PROCEEDINGS.

Street Railway Association of the State of New York.—At the annual meeting held in New York, Sept. 15, a report on "Electric Motive Power for Street Railways" was presented by Mr. John N. Beckley, an abstract of which, with discussion, is given in another column. The following officers were elected: President, John N. Beckley, Rochester; First Vice-President, Thomas H. McLean, New York; Second Vice-President, George Law, New York; Secretary and Treasurer, Wm. J. Richardson, Brooklyn. Executive Committee: President and Secretary, Daniel F. Lewis, Brooklyn; C. Densmore Wyman, New York; Charles Cleminshaw, Troy. The next meeting will be held at Saratoga Springs, N. Y., in September, 1892.

New York Railroad Club.—At the meeting on Sept. 17 about 15 members were present. The Secretary reported the names of 14 applicants for membership, who were duly elected. No papers were presented; but there was some discussion on the best method of setting boiler flues in tube sheets. Mr. West said that the New York, Ontario & Western had had considerable trouble in keeping flues tight on some classes of locomotives. Mr. Lewis, of the Delaware, Lackawanna & Western had had much trouble with semi-steel tubes, but not with iron. In setting tubes he rolls them with a Dudgeon expander driven by a Stow flexible shaft. The subject was continued to a following meeting. Several members proposed topics for discussion at future meetings. The next meeting will be held on Oct. 15.

Engineers' Club of Philadelphia.—The first fall meeting will be held Oct. 3. The subject for the meeting will be "Power Transmission," and it is expected that a paper on landlocked navigation along the Atlantic coast through the bays and inlets will also be presented.

Early in the year this club was practically reorganized, a new constitution and by-laws being adopted, by which many of the duties which heretofore have devolved upon the secretary were transferred to the several committees of the Board of Directors.

Shortly after assuming its duties, the present Board of Directors took up the question of the incorporation of the club, and upon its recommendation the club, at the business meeting of April 18, unanimously directed that the necessary steps be taken for this purpose. A. J. Rudderow, associate member of the club, promptly drew up a form of charter and brought the matter before the proper court, where it still rests, pending the return of the judges from the summer vacation.

HOWARD MURPHY, Secretary.

The Irrigation Congress.—An Irrigation Congress, attended by delegates from 16 Western States and Territories was held at Salt Lake City Sept. 15 to 17, inclusive. The convention organized with C. C. Wright, of California, as President; a Vice-President from each State and Territory; F. K. Gillespie, of Utah, as Secretary. The subject before the Congress was the question, in its various phases, of the future ownership and control of the remaining public lands in the so-called "arid region." The outcome of three days of able and varied discussion was the adoption of the following resolution:

Resolved, That this congress is in favor of granting in trust to the States and Territories needful of irrigation, all lands now a part of the public domain within such States and Territories, excepting mineral lands, for the purpose of developing irrigation to render the lands now arid fertile and capable of supporting a population.

This resolution was in reality a compromise, as there was a strong sentiment in favor of making the cession absolute. The necessity of stopping the destruction of our Western forests was brought prominently before the convention, and was held to be one of the strongest reasons for ceding the lands to the states and territories. It was alleged that the government has completely failed in its attempts to prevent the forest fires which now ruin over 90% of the forests destroyed. The members of the convention thought such destruction would soon be stopped if the forests were under the control of the several states.

Before the close of the convention a committee was appointed to memorialize Congress, and later, A. C. Botkin, of Montana, was made President of the committee, and A. D. Foote, of Idaho, Secretary. A permanent executive committee was elected, as follows: Isaac Trumers, of California; A. W. Hager, of Idaho; S. W. Gregory, of Kansas; W. A. Clark, of Montana; James Stephenson, of Nebraska; W. H. Poole, of New Mexico; J. B. Huntington, of Oregon; J. H. Bailey, of South Dakota; Monigan Jones, of Texas; Edward P. Meade, of Wyoming; Francis G. Newland, of Nevada; W. A. Smyther, of Utah.

The Executive Committee elected Gov. A. L. Thomas, of Utah, President, and W. E. Smythe, of Utah, Secretary. It also voted that the governors of states and territories not represented on the committee should appoint one member each.

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AND

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COMING TECHNICAL MEETINGS.

Engineers' Club of Minneapolis.—Oct. 1. Rooms, Public Library Bldg. Secy., F. W. Cappelen.

Association of Civil Engineers of Dallas.—Oct. 2. Secy., E. K. Smoot, 803 Commerce St.

Technical Society of the Pacific Coast.—Oct. 2. Secy., O. von Geldern, 819 Market St., San Francisco.

American Society of Swedish Engineers.—Oct. 3. At 250 Union St., Brooklyn, and 347 North 9th St., Philadelphia.

Northwest Railroad Club.—Oct. 3. Rooms, Union Station, St. Paul.

Civil Engineers' Society of St. Paul.—Oct. 5. Secy., C. L. Annan.

Engineers' Club of Kansas City.—Oct. 5. Rooms, Baird Building. Secy., H. Goldmark.

American Institute of Mining Engineers.—Glen Summit, Pa., Oct. 6. Secy., R. W. Raymond, 13 Burling Slip New York.

Western Society of Engineers.—Oct. 7. Secy., J. W. Weston, 280 La Salle St., Chicago.

American Society of Civil Engineers.—Oct. 7. Secy., Francis Collingwood, 127 East 23d St., New York.

Engineers' Club of St. Louis.—Oct. 7. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.

Boston Society of Civil Engineers.—Oct. 7. Secy., S. E. Tinkham, City Hall.

Engineering Association of the Southwest.—Oct. 9. Secy., O. H. Landreth, Nashville, Tenn.

Civil Engineers' Club of Cleveland.—Oct. 9. Secy., A. H. Porter, 50 Euclid Ave.

Northwestern Track and Bridge Association.—Oct. 9. Rooms, Union Station, St. Paul.

Atlanta Society of Civil Engineers.—Oct. 13. Secy., Parker N. Black, Room 39, Capitol Block.

Denver Society of Civil Engineers.—Oct. 13. "Municipal Engineering." Secy., Geo. H. Angell.

Northwestern Society of Engineers.—Oct. 13. Rooms, Occidental Block, Seattle. Secy., E. H. Warner.

Civil Engineers' Association of Kansas.—Oct. 14. Secy., J. C. Herring, Wichita, Kan.

New England Railroad Club.—Oct. 14. Rooms, United States Hotel, Boston.

Engineers' Club of Cincinnati.—Oct. 15. Secy., J. F. Wilson.

New York Railroad Club.—Oct. 15. Rooms, Gilsey House.

Scandinavian Engineering Society of Chicago.—Oct. 15. Secy., T. G. Philfeldt, 118 Adams St.

Montana Society of Civil Engineers.—Oct. 17. Helena.

Western Railway Club.—Oct. 20. Rooms, Rookery Building, Chicago.

Engineers' Society of Western Pennsylvania.—Oct. 20. Secy., J. H. Harlow, Pittsburg, Pa.

American Street Railway Association.—Annual convention at Pittsburg, Pa., Oct. 21, 22, 23. Secy., Wm. J. Richardson, Brooklyn, N. Y.

WE give up considerable space this week to a description and illustrations of the terminal improvements of the Pennsylvania R. R. at Jersey City, the most interesting of which is the mammoth trainshed, covered by what is, so far as we can find, the greatest roof ever erected. The only structure approaching it in size is the St. Pancras station of the Midland Ry. in London, which is 690 ft. long with a span of 243 ft. The Pennsylvania trainshed roof is 652 ft. in length with a span between centers of end pins of 252 ft. 8 ins. The design of the St. Pancras roof is in some respects similar to that of the Pennsylvania's trainshed, both being riveted iron trusses of arch form. The total cost of the St. Pancras roof, including the two gables, is said to have been $347,000, according to Mr. SAMUEL REA, in his "Railways Terminating in London."

Another famous great roof, which unfortunately, or perhaps fortunately, never existed except on paper, was designed by order of the Russian Emperor PAUL, in 1781, to cover the Imperial Riding Academy at Moscow. The design was made for a timber roof of 290 ft. span, 1,800 ft. in length, but the building actually erected had the more modest dimensions of 531 ft. x 160 ft., which is, however, a large span for a timber roof.

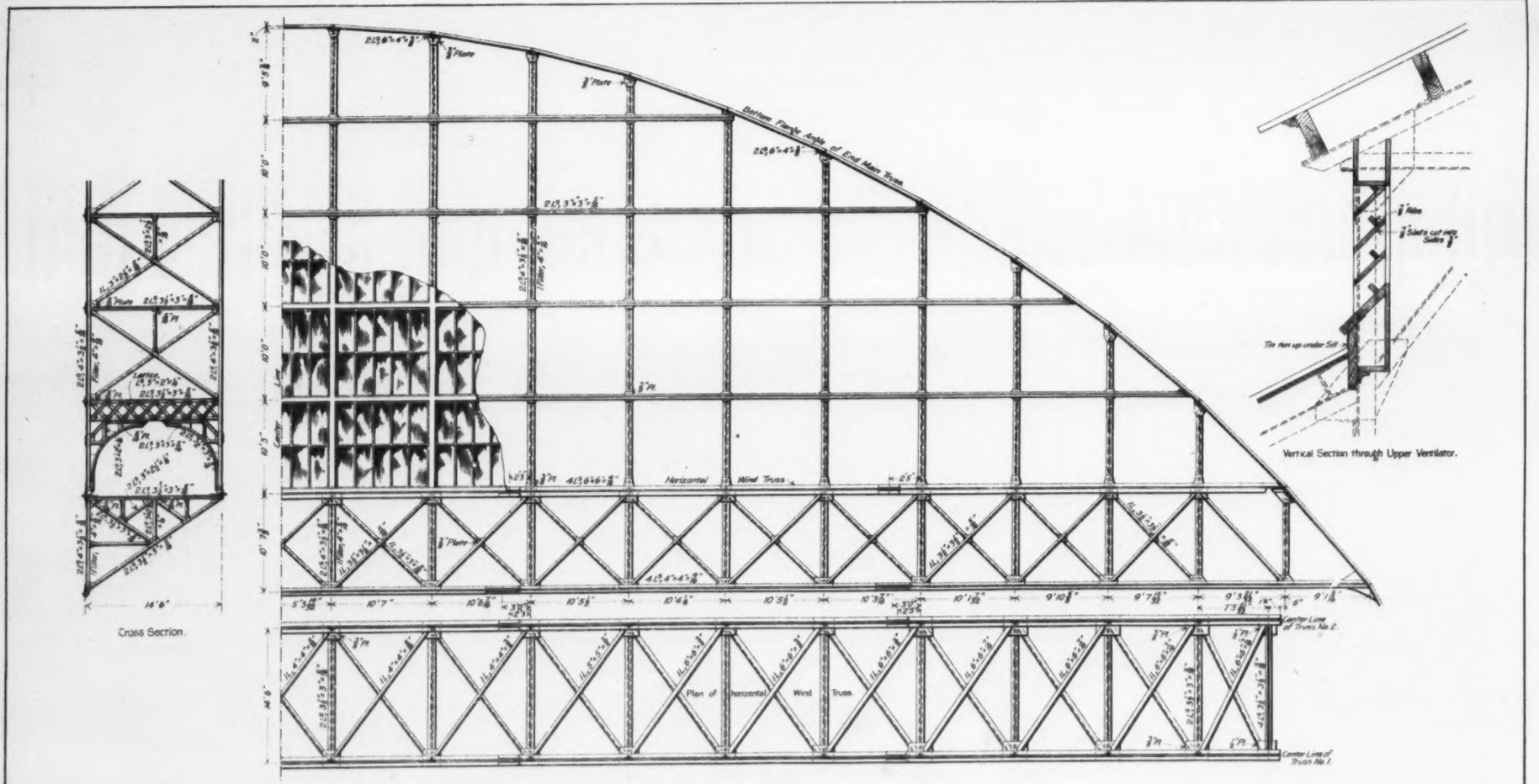
The great structure erected by the Pennsylvania Railroad at Jersey City certainly deserves to rank among the notable buildings of the world. The gain in light, ventilation and freedom from noise due to the use of the high arched roof, are points which railway managers should be quick to appreciate. Although there are few railways which require such extensive terminal facilities at any point as does the Pennsylvania at Jersey City, it seems quite probable that the tendency in the future will be to cover trainsheds with high single span roofs, giving an abundance of air space, rather than with the low roofs supported on columns, which are now a common type.

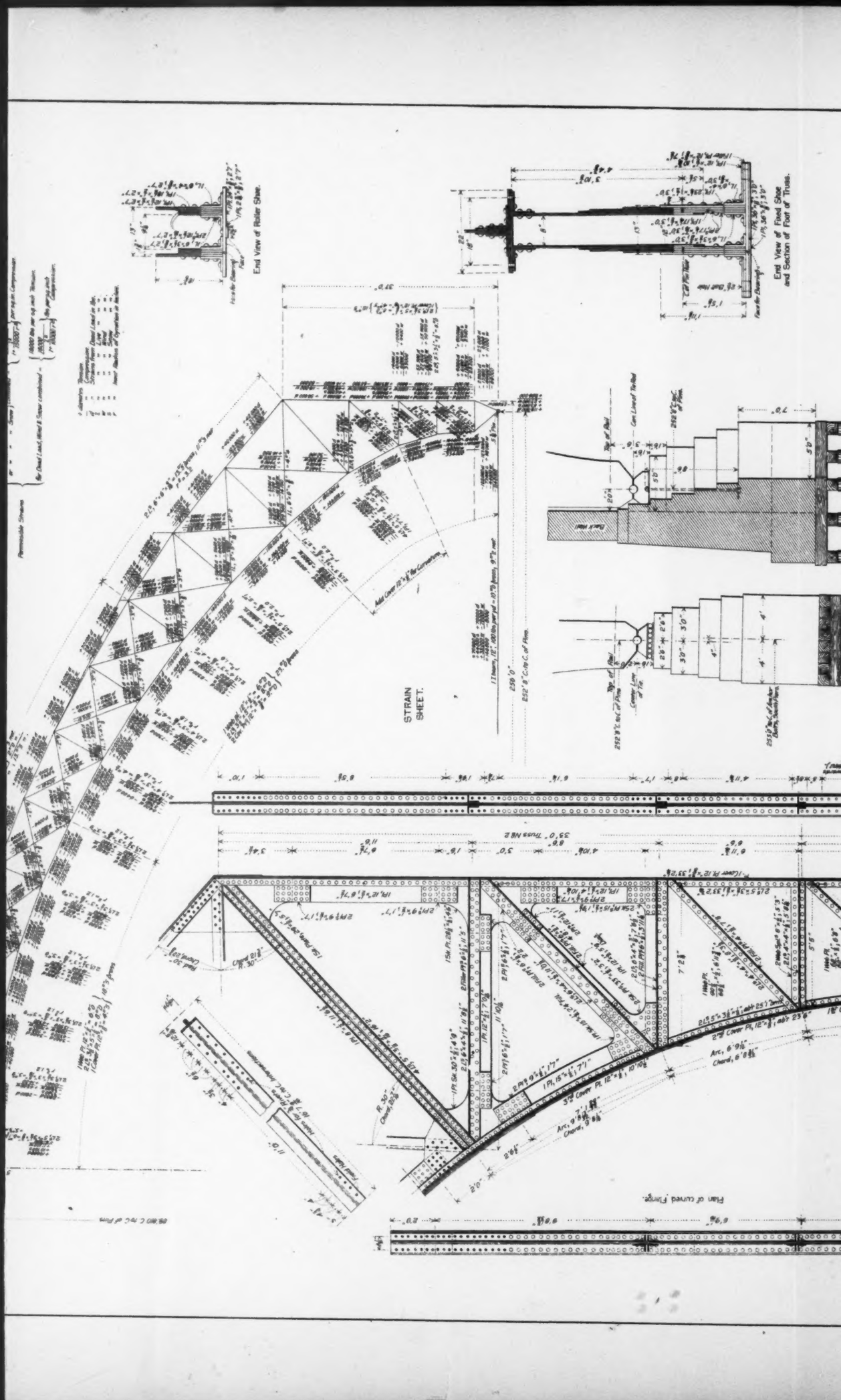
THE question of electric motive power for street railways was considered at the annual meeting of the Street Railway Association of the State of New York on Sept. 15. A committee of one presented a report, which was practically an individual paper, and an abstract of which is given elsewhere. The only system dealt with in the report, and the discussion thereon, was that in which the power is taken from overhead wires, which system is the one most generally used, and with which, consequently, there is most experience. But this system, while practicable and economical, and therefore adapted for certain conditions, is not suitable for city streets. One of the most important movements in municipal matters is that of getting the overhead telegraph, telephone and electric light wires removed and placed in underground conduits, and it would certainly not be consistent to place a new set of poles and wires along the streets. It will be noticed that the paper states that no system but that involving overhead wires can be made a commercial success, and that therefore only lines on that system will be built. Considering the comparative recent date and rapid development of the use of electricity as a motive power, this statement is very unsafe as a prophecy, for as the objections to overhead wires become to be more generally recognized by municipal authorities inventors will naturally devote more attention to systems by which these objections will be eliminated. These objections are more serious than the paper would seem to show. Both storage battery and conduit systems have been operated in some cases as a mechanical and practical success, and it appears quite probable that some one or other of such systems may be improved upon until it becomes a commercial success. When such a result is obtained there will be a very much larger field opened for the introduction of electric railways. At the present time, however, the overhead wire system is showing itself very satisfactory in point of successful and economical operation, and has in consequence had a very rapid and remarkable development. It does not appear probable, however, that it will be the future standard system for city rapid transit.

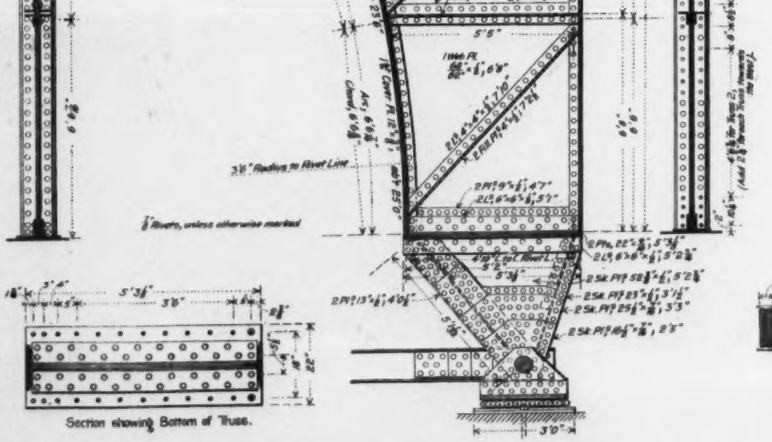
WHILE the collection of statistical matter usually involves an enormous amount of patient and intelligent labor and costs much time and money, its presentation to the public in the form of ponderous volumes filled with tabular matter is, in a manner, a waste of energy, and deprives the information of its most valuable feature—a ready grasp of general results by the great public. To the student of economical science, trained in handling these tables, the detailed data are well enough. But the busy man, to whom these statistics are commercially or socially useful, wants results or boiled-down statements. He cares more for percentages than for the exact figures out of millions, and has neither the time nor the extended experience and knowledge of the subject necessary to exactly or correctly deduce the general data he wants. In this connection the census bulletins issued in advance of the full detail of our last census have done a most excellent work, and the example there set can be followed with profit by engineers and others dealing with bulky tabular matter. Statistics are invaluable in the study or discussion of many forms of engineering work, and their collection is an essential to a clearer understanding of underlying principles or natural laws. But it is a duty that every collector of statistics owes to his fellow engineers or co-workers in any branch of science, not only to present his figures clearly, to give controlling conditions and limitations, and to tabulate his deductions or results so that they can be readily understood, but also, as the one most familiar with all these details, to boil down his results into a general, easily comprehended and easily remembered statement of percentages, wherever this is at all possible.

In this same connection, statistics are too frequently omitted in the description of engineering works. In describing a bridge, for example, a short statement of total length, number and dimensions of spans, width, cost, etc., preceding a general or detailed description of the structure, often furnishes just the information that is wanted, and which has otherwise either to be dug out of a lengthy article piecemeal, or, as sometimes happens, is omitted altogether in some essential detail. This treatment is easier, both for the writer and the reader, for it starts both straight in the path to be followed, and there is less danger of important omissions in commencing with this tabular statement. We speak feelingly, from the standpoint of editors of matter prepared by others at points remote from our office, and we know that many readers will approve of the suggestion here made, in the hope of avoiding the provoking oversight or omission of matter of value too often found in our own and other publications.

STANDARD sand for cement testing has been long recognized as an absolute necessity in comparative tests, and its use is firmly established, but the problem which interested the last general meeting of the Association of German Cement Makers was how to obtain this standard sand, or to secure a constant material from many different sources. Assuming the cement to be constant the adhesion to the sand grains depends greatly upon the size and the shape of these grains. It is generally recognized that an elongated, angular shape in the sand grains is better adopted for binding the mortar together than the spherical shape. The German specification that all standard sand shall be quartz sand prescribes a good material and one that usually has the form first referred to. But how to fix the three dimensions or axes of the elongated

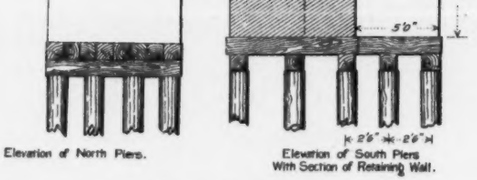

Bottom Flange Angle of End Main Truss
Horizontal Wind Truss
Center Line of Truss No. 2.
Plan of Horizontal Wind Truss.
Center Line of Truss No. 1.
Cross Section.
Vertical Section through Upper Ventilator.
HALF ELEVATION OF GABLE END.
Purlin Truss.


End View of Roller Shoe.
End View of Fixed Shoe and Section of Foot of Truss.
STRAIN SHEET.
Plan of curved Flange.



Section showing Bottom of Truss.

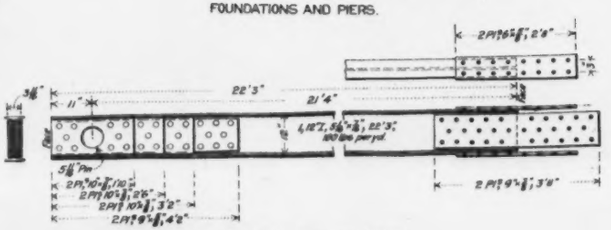
BOTTOM SECTION OF MAIN TRUSSES.



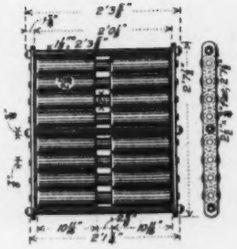
Elevation of North Piers.

Elevation of South Piers
With Section of Retaining Wall.

FOUNDATIONS AND PIERS.



Details of Bottom Chord of Truss.



Nest of Rollers for Expansion
End of Truss.

THE NEW TRAIN-SHED OF THE PENNSYLVANIA RAILROAD AT JERSEY CITY, N. J.

WM. H. BROWN, CHIEF ENGINEER. THE PENCOYD BRIDGE & CONSTRUCTION CO., BUILDERS.

CHAS. HART & SONS, LITH. 90 VESEY ST., N. Y.

sand grain is the problem that bothers the cement testers; and the character of the surface of the grain is still more difficult to ascertain so that it may be made a standard. The makers have suggested two ways out of this difficulty. One is to fix upon some practically inexhaustible source of a proper quartz sand, and of as uniform a character as possible, and use this sand alone as a standard for all tests. The second proposed plan is to manufacture a standard sand of some exact geometrical shape and use this for all tests. The objection to the latter method is the difficulty attending such manufacture, and the fact that the spherical form is the easiest to produce, but is the least adapted to develop the best qualities of the cement to be tested, and the probability is great that all such artificial shapes would be too smooth for obtaining the best results. The only practicable plan for comparing sands from various sources seems to be the macroscopic and microscopic examination of clean quartz sand and from the information thus gained to adopt a standard character of grain, and to compel all other sands to agree with the standard sand in general requirements of form, size and surface.

Another question discussed at this meeting was the possibilty and advisability of substituting sieves made of perforated plate for those made of wire-gauze. They found it impracticable to establish a standard size of round hole which would give the same results as the square opening made by interlacing wires; and the same sand gave different results when passed through the two sieves. The use of a sieve with a circular hole has the effect of selecting the spherical grains, and this not only alters the size, but also the shape of the standard sand grains. The committee also found that sieves of perforated plate become easily blocked up and require frequent cleaning. This cleaning means wear and destroys to a considerable extent the advantages claimed for the plate sieve, that is, the displacement of the wires in the ordinary sieve causing them to be inaccurate. The general consensus of opinion was against the perforated plate sieve and favored the selection of a good, clean, sharp sand, then to note its general character, size it in sieves of standard mesh and wires, and then issue this sand to all testers of cement and as a standard to compare other sands by. The present practice in fixing upon a standard sand is practically very much mixed, and yet it is so important an element in reliable comparative tests of cements that it is to be hoped that the late discussion will lead to the adoption of some universally recognized standard.

OUR London contemporary, the *Engineer*, has shown again, in a paragraph in a recent issue, that it does not understand American railways, but nevertheless undertakes to write about and criticise them without even taking the trouble to looking up information before making its remarks. The paragraph is as follows:

> A "palace" car has just been built in Massachusetts for the Montreal and Toronto line of the Canadian Pacific. "It is 66 ft. long; the central 'drawing-room,' which is turned into a dormitory at night, is 32 ft. in length, 9 ft. in width and 10½ ft. in height, and is furnished with a dozen easy chairs. It is said that the ceiling is frescoed with designs representing the four seasons, and a striking novelty consists of six bay windows. Besides this apartment there are lavatories, where a quantity of powdered soap slides into the basin of water on touching a button; a kitchen, a safe for valuables, an 'observation room,' a private state-room, a library with writing desk and medicine chest, and other conveniences. The car is ventilated by compressed air and heated by steam from the engine." How long will it be before this nice little carriage of 66 ft. length is derailed.

The car as described does not appear to present any particularly novel features of American practice, and bay windows are by no means a striking novelty at this date. The substance of this paragraph is apparently quoted from some other source, judging by the quotation marks, while the final sentence was evidently added by our contemporary as a piece of "smart" writing. It was evidently intended to be sarcastic, implying that the length of the car was excessive and dangerous, whereas a length of 66 ft. does not call for special remark in a country where cars of 60 to 70 ft. in length are quite common, and where the maximum length is about 75 ft. These facts might easily have been ascertained, as well as the fact that the Pullman cars on English railways are over 60 ft long, but do not evince any special predilection for jumping the track. Perhaps our contemporary does not know that Canada, in the very early days of its railway history abandoned the English system of rolling stock with its rigid wheel base, and adopted the American system with its more satisfactory arrangement of trucks or "bogies," giving a short rigid wheel base and a long total wheel base. This American system of running gear has also been adopted to a considerable extent on English railways. In WELLINGTON'S "Economic Theory of the Location of Railways" is given a table of dimensions of American cars, from which we take the following lengths:

	Length.	
	Body.	Over al
	ft. in.	ft. in.
Passenger	46 6	52 9
Baggage	40 0	46 0
Mail	60 9¼	66 11¾
Sleeping car, old style	58 0	64 8
Dining car, C. B. & Q. R. R.	64 0	.....
Monarch sleeping car	.....	75 0
Parlor car, B. & O. R. R.	58 0	65 0
Woodruff sleeping car	.....	71 0

To this we add the following, and to the lengths of body must be added about 7 ft. for the two platforms.

	Length over body.
Monarch parlor car	66 ft. 0 in.
New York Central R. R., compartment sleeping car	65 " 10½ "
Baltimore & Ohio R. R., parlor car	67 " 0 "
Pennsylvania R. R., dining car	61 " 6 "
Boston & Albany R. R., standard pass. car	58 " 6 "
Central R. R. of New Jersey, club parlor car	66 " 1½ "
	Length over platform.
Chicago & Alton R. R., compartment sleeping car	75 ft. 2 in.
Baltimore & Ohio R. R., buffet car	70 " 0 "
	63 " 10 "

The length of English cars ranges from 26 ft. (London, Brighton & South Coast Ry., four-wheel suburban cars) to 34 ft. (Great Eastern Ry., six-wheel main line cars) for those with rigid wheel base; and from 42 ft. 6 ins. (London & Southwestern Ry. car on four-wheel trucks) to 56 ft. (Midland Ry. car on six-wheel trucks) for those carried on trucks or bogies. As to the question of how long before this Canadian 66-ft. car is derailed, that depends upon circumstances and not upon the length of the car. It is not improbable that, like other cars of this type, it may run for its lifetime without such an accident. The trouble is that our contemporary is so prejudiced against American railways that it is always ready to jump at any apparent chance to reflect unfavorably upon them, with the frequent result, as might be expected, of being itself in the wrong.

WHILE on the subject of the comparative dimensions of English and American railway cars, we may mention the fact that the smaller limits of the English loading gage, owing to the smaller headway and width of bridges, tunnels, etc., precludes the possibility of making the interior of their cars as commodious or as effective in appearance as the American cars. In this country the width is from 8 ft. 6 ins. to 9 ft. 8 ins. inside, and the interior height from 7 ft. at the sides to 9 ft. 6 ins. at the middle. In England the extreme outside width is about 8 ft., and the interior height from 6 ft. to 6 ft. 6 ins. at the sides and 7 ft. to 7 ft. 6 ins. at the middle, or exceptionally 8 ft. 6 ins. to the top of the monitor roof, as on some of the Great Western Ry. cars. In consequence, not only are the doorways more awkward and the space more limited, but even in cars of the American type on English railways the pleasing interior effect of our wide and lofty cars is entirely lost. This is particularly noticeable on the Pullman cars on English railways, and on some handsome drawing room cars built in this country for an English railway. We shall probably have more to say on the question of English and American rolling stock at a later date, but we have said enough at present to show conclusively that our contemporary is not competent to act as a critic of American railways, although it not unfrequently assumes to act in that capacity. It may not be amiss to again call the attention of our contemporary to the wisdom contained in the remark of Josh Billings, that "It is better not to know so many things than to know so many things that are not so."

AT a point in New Jersey only eleven miles from New York City two railways cross each other at grade. Both carry a heavy suburban passenger traffic. One, a single track road, runs 23 passenger trains a day over the crossing; the other, a double track line, runs 53 passenger trains daily over the crossing; the bulk of these trains on both roads, are moved in the morning and evening hours. Both roads run trains over the crossing without stopping. There is a watchman's station at the crossing, and mounted on top of it is an antiquated type of pot signal which indicates to the enginemen on the double track road whether the track is clear for their trains. A semaphore signal, also located at the crossing, governs the single track road.

The country is somewhat broken and wooded, so that enginemen on one road cannot see approaching trains on the other, but the crossing is approached by a long tangent on both roads, so that in clear weather enginemen can see the signals as far as their eyesight will permit. But it is not always clear weather here. Probably on at least thirty days in the year the numerous morning trains are moved in a fog in which such a signal as that governing the double track road above described cannot be distinguished three car lengths away. On Thursday morning of this week there was such a fog, and a wild freight train on the double track road moved slowly up toward the crossing while the engineer peered forward and tried to see whether the red or the white target of that little pot signal were turned toward him. But before he found out that it was the red target which was displayed, he saw a passenger train on the other road moving over the crossing in front of him. Luckily he was moving slowly; but even the driver brake and plenty of sand on the rail could not stop the freight train in time, and the locomotive struck the smoker of the passenger train amidships, and knocked it off the trucks so that it effectually blocked both tracks of the double track road. Fortunately nobody was hurt; but most unfortunately the property damaged was hardly heavy enough to teach the railway managers what a pennywise-and-pound-foolish policy they are pursuing.

The grade crossing of two railways over which passenger trains pass so frequently ought to be protected by interlocking home and distant signals and derailing switches. But one company is too poor and the other is too rich to indulge in modern improvements of this sort. As the railways in New Jersey make the laws to suit themselves, they can do about as they please in the matter of safety appliances. But self-interest alone ought to be sufficient to teach the managers of these roads that to omit distant signals at a grade crossing, and maintain a watchman there to work the home signals is like employing a policeman to guard the front door, and leaving the back door open for the entrance of thieves. The next accident at this point, where trains cross by the schedule within a minute of each other, may not result so fortunately; and the expenditure of fifty

dollars or so for distant signals would be very cheap insurance against possible heavy damages for deaths and injuries.

Legal Standard Time in Canada.

An act "respecting the reckoning of time" is now before the Canadian House for discussion only, no attempt being made to pass it at this time. This act is founded upon the action of the international conference held in Washington in 1884, at which the representatives of twenty-four nations, including Canada, discussed the leading principles which should guide the inhabitants of the world in fixing upon a common system for reckoning time. After prolonged deliberation this body practically unanimously declared that: (1) The prime meridian common to all nations should be the meridian passing through Greenwich. (2) That the mean solar passage on the anti prime meridian should be the zero for reckoning time. (3) That there should be a universal measure or standard of time common to all nations. (4) That such universal standard should correspond and be identical with the mean civil day at Greenwich, excepting only with respect to the notation of the hours, which should be in a single series from 1 to 24.

This latter resolution approves of the hour zone system already introduced into many parts of Europe, America and Asia to great public advantage. Canada has also adopted the new method of reckoning time; but doubts have arisen as to the limitations of the zones and as to what was the legal time in many places, and this proposed act is intended to remove this doubt.

Under its provisions, Canadian time is hereafter to correspond, except in hour notation, with Greenwich civil time. It is to be regulated in accordance with the hour-zone system, based on hour meridians, or multiples of 15 degrees from the prime meridian, numbered westward from the anti-prime or zero meridian in regular order. In accordance with this decision, hour meridians are numbered from 16 to 20 westward, the first, or No. 16, being in 60° west longitude, or 4 hours behind the universal standard time at Greenwich. Meridian No. 20 is in 120° west longitude or 8 hours behind Greenwich time. The commencement of the day and notation of the hours in any zone or section of the country may vary according to the hour meridian chosen to regulate the reckoning. But the division of time into hours, minutes and seconds shall be synchronous throughout Canada and identical with the Greenwich subdivision.

As Canada is a country of great width east and west, and comparatively sparsely settled, the fixing of the exact limits of the hour meridians would be a work of difficulty from a practical standpoint. The proposed bill, therefore, fixes geographical limits, or decides in what provinces the various hour meridians shall rule. For example, hour meridian No. 16 controls the reckoning of time throughout Prince Edward Island and Nova Scotia; meridian 17 does the same for New Brunswick, Quebec, Ontario and all parts of Canada lying east of Manitoba and Keewatin, not including Prince Edward Island and Nova Scotia; meridian 18 regulates Manitoba and Keewatin; meridian 19 controls Assiniboia, Saskatchewan and the territory east of Athabasca and west of Keewatin, and hour meridian No. 20 has effect over Alberta, Athabasca, British Columbia and all territory to the north thereof. The bill practically leaves it open for the governor of any province to select which hour meridian would be preferred in his territory, provided that it is set forth and defined by proclamation. The 24-hour notation would be equally valid with the older form under the provisions of this bill.

We have been asked by a Canadian correspondent what we think of this proposed bill and we answer as follows: We have no hesitation in heartily approving of the movement to adopt standard time and to legalize the hour-zone system and also the 24-hour division of time, but we must protest against the fixing of this legal time by accidental political boundaries as proposed in the bill of Mr. TUPPER. Universal standard time, to be of any real value, must be what its name implies, and the whole purpose of the Washington conference, upon which this bill is supposed to be based, was to obliterate political or national boundaries and to establish a standard of time for the whole world. This Canadian bill in a manner recognizes the difficulties in the way of fixing the zone limits, but carefully avoids solving the problem presented, and substitutes a system that is not correct for Canada and will not fit any system possible of adoption by the United States.

Canada is unfortunately situated, geographically and politically, for the easy adoption of fixed hour zones, but it is not as badly off in this respect as the United States. Both countries cover an enormous area east and west, or in the direction of time notations and the boundaries of states and territories in no way coincide with the meridians which are fixed upon by the Washington conference of 1884 as points of departure for time reckoning. But the proposed bill makes confusion worse confounded in Canada. If we take the Province of Quebec, for example, throughout which it is proposed to reckon all time as five hours behind the "universal Greenwich standard," we find that it really extends over about 25° of longitude and actually includes within its borders the notation of two different hour meridians. But in the cases of Assiniboia and Saskatchewan, the true hour meridians cut almost the middle of each of these provinces, where they properly belong. Ontario also has properly, within its borders two hour meridians.

As each province, under the provisions of this bill, can decide for itself what hour meridian it will adopt, the apparent purpose of its framers is to avoid having different standards for the several parts of one province. And in this they feel supported by the difficulty of fixing, in a sparsely settled country, the exact location of the hour meridians. There is a difficulty here; but we think it disappears when weighed with the true purpose of the adoption of any so-called universal standard. In Canada, practically every political boundary extending north and south and parallel with the hour meridians is fixed by instrumental work, and not by natural boundaries such as great rivers and mountains. The lower half of the eastern boundary of British Columbia is the only exception, and the definition of a boundary formed by a mountain chain is one above all others needing the surveyor's art.

This being the case, it is no more difficult, in time, to settle upon the points intersected by the limits of an hour zone than it is to exactly fix where British Columbia ends and Alberta begins, for example. As to a difference in legal time in two parts of one province, this does not seem to be as important as it is to avoid a wide divergence from true time in some part of the same province. This latter error, which would be very perceptible in the Provinces of Ontario and Quebec, would be an especially unfortunate result of legislation which has for its alleged purpose the establishment of "standard" time, and is based in its preamble upon the resolutions of a congress that had under consideration the fixing of a universal standard of time. It will not do to argue, in the case of Quebec or any other province, that the points where the legal time would diverge most from tone time, were now almost uninhabited. In this rapidly moving Century no one can tell how soon these sections will be settled, and a law should be framed to meet such contingencies.

One of the chief uses of a universal standard is the fixing of time tables for railway travel; and as the railways of Canada connect over half the extent of that country with those of the United States, the arbitrary political division of time here proposed would bring in an element of confusion that would make it impossible of application at all and be worse than the multiple "standard" of time on railways that it is supposed to supplant.

In the United States the hour meridians of 75°, 90°, 105° and 120° west longitude from Greenwich are well established, and without regard to political boundaries. According to the report, of Jan. 21, 1891, of the special committee on Standard Time of the American Society of Civil Engineers the representatives of 140,000 miles of railways have approved of the 24-hour notation of time, and have practically accepted with this the hour meridians above given. The action of the International Convention, held in Washington in 1884, has not yet been authoritatively recognized by Act of Congress, but the American Society of Civil Engineers has recommended such action to the President in a memorial, and a bill is now before committees of the House and Senate calling for such approval by the government. Sec. 3 of this bill states that the different time sections called for by this act shall embrace the country "on each side of and contiguous" to the hour meridians. But it is also competent for the constituted authorities of any state, city, incorporated town or village to adopt such hour meridian for its use as shall seem to each of them most convenient, and such standard shall be legal and be recognized by the courts and officials of the United States. This section is evidently intended to apply to those located near the line bounding two time zones, and leaves the people to elect which shall be the standard for them.

The hour-zone system, or what is more usually called "standard time," divides the circumference of the globe into 24 sections or zones, with the hour meridian passing through the middle of the zone, each such hour meridian being distant 15° of longitude from the adjoining hour meridian. The anti-prime meridian, or zero, from which the hour meridians are numbered consecutively westward, is the meridian opposite to that of Greenwich or 180° east or west, making the latter the 12th hour meridian. This system has been adopted for ordinary use in portions of Europe, Asia and America. In 1887 Japan officially adopted the 3d hour meridian for reckoning time. In England and Scotland it is the 12th hour meridian, or Greenwich; in Sweden it is the 11th and is the same in Austro-Hungary. Germany and other Continental countries are still at work seeking for a proper point of departure. The question of fixing boundary lines for these zones is still a mooted one, and natural, geographical or commercial circumstances now decide in various places which shall rule. But it is evident that the full purpose of these zones can only be realized by the adoption of the zone lines as they come, regardless of the accidental divisions here noted; and the countries of larger area, like the United States and Canada, must decide upon this point. Legislation is undoubtedly needed to define where one zone ends and another begins; but this Canadian bill would establish a bad precedent for such division and lacks the essential feature of fitting adjoining time zones.

THE ST. CLAIR TUNNEL was formally opened to traffic, on Sept. 19, by Sir HENRY TYLER, the President of the Grand Trunk Railway, and in the presence of many invited guests. The party, leaving Sarnia, passed through the tunnel, and was welcomed in Port Huron by Hon. WM. MCILWAIN, the Mayor of the city. To this speech responses were made by Sir HENRY TYLER, ERASTUS WIMAN and others. On the return to Sarnia a luncheon was served and toasts were drank and replied to.

CORRESPONDENCE.

Finding a True Meridian.

BATESVILLE, Ark., Sept. 15, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I am much interested in the communication of HOSEA PAUL. Nothing but practical experience could ever have induced Mr. PAUL to say, "Very little practical use is ever made of such knowledge" (*i. e.*, empirical rules for finding a true meridian as laid down in the books), for the cogent reason that not one of those rules is of practical application once in twenty times.

Take the rule given in the U. S. Manual of the upper and lower transit of Alioth. South of 38° 30′ you cannot see Alioth in lower transit; north of 34° 30′ you cannot get your eye in a position to see the upper transit through the telescope of any ordinary instrument.

Following Polaris with the slow motion screw to its greatest eastern or western elongation is slow and tedious, but with good azimuth tables is very accurate; still it is not precise.

Mr. GILLESPIE, in his invaluable work, tells us how to test the verticality of the vertical wire by cutting a star high in the heavens with the wire and then cutting its image in a pool of water. This with 999 stars in a thousand is the best proof that the vertical wire is not in adjustment.

But this is a digression. Take the sun as it shines at convenient hours. I have a rule of my own, a rule that is accurate and reliable, requires no complicated calculations. It is not for sale, neither do I want a stamp, as I can pay my own postage. Ask for it and I will send it to you.

And now, my brother surveyor, do not say any more about convenient hours. They are no part of engineering. We are not born at convenient hours, and must die by the same schedule; a convenient hour for us is a good time to look to our employer's interest. The most we can hope for is that in the "great day" our manifest may come in at a convenient season.

ARTHUR F. BENSON.

Determining the True Meridian: Corporation Appreciation of Engineers.

CLIMAX, Mich., Sept. 13, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I note in a late number of the NEWS a communication from W. L. MARCY giving a method of determining a true meridian by observation on Alioth and Polaris, also communication from HOSEA PAUL relative to the use of the true meridian by civil engineers and surveyors. The latter states that while most members of the profession are supposed to know how to determine meridian by the old methods, "very little practical use is made of such knowledge," and "observations are rarely taken for this purpose." All of which is very true, and for the very good reason that it is very seldom that the value of the knowledge to the surveyor is equal to the cost and trouble of getting it. In all that part of the United States where the original land surveys have been made and the land sold or on sale in accordance with them, the land surveyors' work now consists almost entirely in retracing the lines of the original survey and subdividing its tracts into smaller ones. For these purposes it is of no consequence to the surveyor to know where the true meridian is. In retracing old lines he is concerned to know where they were actually located, and not where they ought to have been. The instruments with which and the manner in which the original land surveys have been made in this country thus far are such that when the surveyor has found the true meridian he knows no more about the location of the line he is seeking than he did before. If it were known that the original surveys were made by the true meridian, or if the exact divergence were known, a knowledge of the true meridian would be of greater value, but this is so seldom the case that it is unsafe to assume it. If the lines of the original surveys can be definitely located with reference to the true meridian it will not be convenient to use the stars as monuments in locating the lines when nearer monuments can readily be found. Except in the original surveys yet to be made that is all it will amount to in land surveying. F. HODGMAN.

P. S.—I also notice with great pleasure the action of the Canadian Pacific R. R. officials relative to the work of FRANK P. DAVIS on the location of its Rocky Mountain division. I feel like putting on record another case by way of contrast. In the spring of 1881 I was transitman under Mr. FRANK P. DAVIS as chief of party engaged in the location of the Denver & Rio Grande Western R. R. in eastern Utah. M. T. BURGESS was chief engineer of that line, and Major M. F. HURD was resident engineer in charge of the location from Green River to Tucker or Clear Creek. Under their direction Mr. DAVIS was locating a line down the Price River and meeting no serious difficulty. Suddenly the party was recalled and set to work on a new line, leaving the Price River and running over the San Rafael swells, and the line thus located was graded. I am informed that this was done by order of officials in Colorado in opposition to the advice of Mr. BURGESS and Major HURD. In the meantime Mr. FRANK P. DAVIS was promoted to resident engineer in charge of the work formerly under Major HURD. While holding this position he made an examination of the lower Price and Green River cañons, and finding a line practicable down them caused a survey of the line to be made. I had charge of one of the two parties which made the survey. It developed the fact that it was cheaper to throw away about 70 miles of line between the Price and Green rivers already graded, and build on the new line, than it would be to iron and operate the old one. As soon as this fact was fully shown Mr. DAVIS, myself and every other engineer who had anything to do with running the new line were summarily dismissed from the service of the company, and Mr. GEO. GOSS was the man through whom the dismissal came. Mr DAVIS went direct from this work to the Canadian Pacific. His work was equally good on the Denver & Rio Grande and on the Canadian Pacific. One road dismissed him for doing good work, the other has rewarded him. F. HOLGMAN.

River Profile Machines.

ST. LOUIS, Mo., Sept. 15, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Recent notices of devices to make a continuous profile of river bottoms give the impression that they are a new invention. The principal feature, a lever of which the long arm dragged on the bottom and the short gave opportunity to read off the depth, was subject of a patent by one Negley in 1867, independently thought of and worked out by me in 1870, and applied in practice; not a single profile but 8 parallel profiles 10 ft. apart, taken located and recorded at a single operation.

In report of Chief of Engineers, 1871, page 278, will be found: "In working up the results of the surveys of 1870 my attention was drawn to the numerous errors made in reading and recording depths measured by hand and the failure to develop the shape of the bottom by detached soundings; also, it was found a very laborious matter to test the excavated channel for lumps and ridges.

"These considerations led me to study the problem of mechanical sounding under the conditions noted; the result was a machine working on the principle of the panta graph, recording a continuous profile of the ground passed over. . . . After being fully tested the machine was purchased for the Government on your recommendation."

About the same time E. H. Hoffman, C. E., employed on the Rock Island Rapids Improvement, invented, built and successfully used a sounding machine by which depths measured vertically were recorded mechanically. His machine, like mine, covered a space of 80 ft. in width. His machine was suited to a rock bottom, mine to a bottom of sand or clay, neither good in mud nor for depths greater than 15 ft.

An assistant on the lake survey about the same time hit upon the dragging lever, and his plan is illustrated in one of the engineer's reports; if my memory is correct, Capt. W. R. Livermore, in 1872. The profile taking device is, therefore, not new; but, as I can certify, is practical and useful. ROBERT E. MCMATH, M. A. S. C. E.

Solution of Right Angled Triangles with Relatively Small Perpendiculars.

ALBANY, N. Y., Aug. 24, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The formula given in your volume for 1889, Dec. 21, p. 595,

$$x = \frac{a^2}{2h} \qquad (1),$$

for determining the difference in length, x, between the base, b, and the hypothenuse, h, of a right angled triangle whose perpendicular is a, is a most useful one, but it can easily be extended so as to apply to a larger number of cases. If the well known formula—

$$h = \sqrt{b^2 + a^2} \qquad (2)$$

is developed by the binomial formula it will become—

$$h = b + \frac{a^2}{2b} - \frac{1}{8}\frac{a^4}{b^3} + \frac{1}{16}\frac{a^6}{b^5} - , \text{ etc.} \qquad (3),$$

or, replacing the terms $\frac{a^2}{2b}$, etc., by c, c_1 and c_2.

$$h = b + c - c_1 + c_2 \qquad (4),$$

neglecting the succeeding terms of (3).

Now c_1 is evidently equal to $\frac{c^2}{2b}$ and $c_2 = \frac{cc_1}{b}$, hence—

$$h = b + \frac{a^2}{2b} - \frac{c^2}{2b} + \frac{cc_1}{b} \qquad (5),$$

Placed in this form it is evident that formula (1) is made more precise by computing a second term $\frac{c^2}{2b}$ from the value first found for $\frac{a^2}{2b} = c$, and if necessary a third term $\frac{cc_1}{b}$ can easily be found from the values of c and c_1.

The great advantage of the extension of formula (1) into (5) arises from the fact that the second term $\frac{c^2}{2b}$ can always be computed with ease, and if found to be so small as to be safely neglected absolute confidence can be had in the simple formula (1).

To take a numerical example from those given in the number of ENGINEERING NEWS referred to:

base = 100 altitude = 20

$$c = \frac{20^2}{200} = +2.$$

$$c_1 = \frac{c^2}{200} = -.02$$

$$c_2 = \frac{cc_1}{100} = +.0004$$

hypothenuse = 100 + 1.9804

Again, with base = 4, altitude = 3, the hypothenuse is found to be 5.011.

To find the base from the hypothenuse and the altitude, 5 can be inverted, and will become, with sufficient exactness—

$$b = h - \frac{a^2}{2h} + \frac{c^2}{2h} - \frac{cc_1}{h} \qquad (6),$$

which formula is usefully applied to the case of accurate measurements on rough ground, *e. g.*, the accurate location of monuments for street corners in advance of grading. Let a stake be driven at every tape length, measure with inclined tape from top to top of stake, then level between the stakes and compute the horizontal distances from formula (6) with a table of squares. The numerical work will be very simple if a 50-ft. tape is used, though a few shorter distances may be necessary, in very rough ground. HORACE ANDREWS.

House Drainage.

BOSTON, Mass., Sept. 19, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The paper by Mr. F. G. CORSER, extracted from the *Northwestern Architect* and printed in to-day's ENGINEERING NEWS, deals with a subject calling for the fullest and most open interchange of opinion. Without being able to go quite as far as he does in criticising the ideas now prevailing among authorities on house drainage regulations, it cannot be denied that Mr. CORSER's views, resulting from much independent observation and study, are pregnant with good sense in many important respects. In particular, it seems to me that his predilection for increased simplicity in house drainage design is deserving of encouragement and adoption, for a tendency toward complication has been inevitably fostered by the conflicting claims of rival patentees dealing with "traps" and other special fittings. The result of this has been to induce, in the minds of house owners and professional advisers alike, a sense of blind reliance upon sanitary specialties, to the exclusion, in many instances, of at least equally important matters, such as sound pipe-laying and plumbing. I am in no wise surprised to glean from Mr. CORSER's paper that a reaction has set in, of such force, indeed, that even the vaunted "running" or "disconnection" trap is at last losing ground.

I have but little acquaintance with the use of this particular appliance in this country, but in England it was, until recently, an approach to heresy to breathe a word against its use. It is a cardinal feature of the Model By-Laws issued by the Local Government Board, the London ministerial department charged with the control of local sanitary boards throughout England and Wales, and it is within my experience that earnest and well-meant attempts to modify this "model" code in individual cases, so as to leave a discretionary power as to the need for absolute "disconnection," have invariably failed to move the powers that be. In one case, that of Leicester, it is true that the objectionable compulsory adoption of this feature was avoided, but this was effected by passing the proposed bye-laws through Parliament, as part of a special local act, thus getting over the necessity of a direct application to the central board. "Disconnection" has, in fact, during the last 15 years, come to be regarded as a shibboleth in English sanitary circles, but indications of a revolt against a hard and fast system are by no means lacking, and such views as those expressed by Mr. CORSER are becoming more and more common among thoughtful and independent observers. It must be admitted that there were, in England, many potent reasons why such a system should be eagerly hailed as a supposed panacea against the passage of sewer air into old and faulty house drains, but it has none the less been carried to a ridiculous excess, and the reaction, when it comes, may prove even worse than the original blunder, by encouraging a belief that *all* safeguards of this character are delusive and superfluous, and that the speculative builder may safely be allowed to resume his old position of hygienic autocrat, to the exclusion and discomfiture of skilled sanitary specialists.

The advocates of an uninterrupted connection between street sewers and house drains have a strong support for their views in the case of Frankfort-on-the-Main, Germany, where house drainage by-laws, adopted in 1868, fully recognise the mutual independence of the two con-

duits. In that city the street surface ventilators, placed at an average distance of forty yards apart, act mainly as down cast shafts, the up cast being provided by at least one vertical ventilating pipe to each house, without the intervention of an underground siphon. It would be interesting to have, from some of your readers and contributors, some account of present house drainage practice in that well known European city, and I trust this may be forthcoming.

Mr. CORSER's method of dealing with sink wastes by discharging them within the dwelling over the upper edge of water closet and other basins, is the same in principle as the English system of disconnecting these wastes by passing them through an external wall, and there discharging them over open-air gully gratings. This is, no doubt, a good rough and ready mode of insuring an absolute "disconnection," but it is at best a clumsy and inartistic treatment, and in such a winter climate as I find in America would be, I am sure, wholly inapplicable. At one time English feeling ran so strongly and inconsiderately in favor of this class of "air break" that, so long as the sink waste so treated was no more than a few feet in length, no trap was considered necessary for it; but it is now abundantly admitted that the fouled surface of even a short leaden waste gives off odors which nothing short of trapping will shut off. The "bent pipe" form of trap, with screwed bottom cap, recommended by Mr. CORSER, is largely favored in England, but I am unable to follow him in his advocacy of a 4-inch seal, knowing, as I do personally, that traps having a 2½-inch dip gave trouble in Frankfort more than twenty years ago. Traps having a more moderate depth of water seal can be run more safely, and generally applied, and in many cases I believe the relieving "air pipe" at the upper end, though condemned by Mr. CORSER, is of service in connection with them. Let me add, however, a final word as to my entire agreement with him on the uselessness of "cowls" at the upper extremities of soil pipes. I know of no sanitary detail which has been so thoroughly and extravagantly exploited as these utterly redundant specialties have been in England, and I am led to judge, from Mr. CORSER'S paper, that the craze for them has obtained a good hold in America. JOHN S. HODGSON, Assoc. M. Inst. C. E.

Notes and Queries.

H. L. N., of New York City, asks who is the inventor of or who controls the patent for the roller toboggan slide used at Coney Island and similar resorts? We do not know but probably some of our readers can answer.

B. F. LA R., of Jackson, Mich., inquires if there are any experiments on cast iron columns published other than those of Hodgkinson? Can any of our readers tell of such experiments and where the results can be obtained?

C., of Saugatuck, asks concerning a receipt for making brick masonry water tight. In the *Transactions* of the Am. Soc. C. E., Vol. I., p. 203, will be found an article upon this subject fully describing the Sylvester process. This consists of using two washes or solutions for the surface. The one is made of ¾ lb. Castile soap to 1 gallon of water; the second of ½ lb. alum to 4 gallons of water. Both must be thoroughly dissolved; the wall must be perfectly clean and dry and the temperature of the air not below 50° F. The soap wash is laid on boiling hot with a flat brush, taking care to avoid making a froth. This wash should remain 24 hours and be dry and hard before the alum wash is applied. The latter is also put on hot and allowed 24 hours to dry, and the process is repeated until the wall is impervious to moisture. The cost of applying 4 coats each of the soap and alum solutions to the Croton gate houses was 10.06 cts. per sq. foot. A wash made of pure cement of good quality applied on the inside or water face of vertical walls is also effectual and has been often used.—ED. ENG. NEWS.

The Comparative Merits of Various Systems of Car Lighting.

X.

OIL-BURNING LAMPS.

(*Continued from page* 253.)

Concerning the desirable qualities in the oil used for car lighting, we cannot give our readers better information than to quote from the admirable series of articles by Dr. C. B. DUDLEY, Chemist, and F. N. PEASE, Assistant Chemist of the Pennsylvania R. R., on "Chemistry Applied to Railroads," published in *The Railroad and Engineering Journal*. By permission of the author, and publisher, we reprint the following from the articles on "Petroleum Products" in the issues of that journal for April and May, 1890, taking so far as possible only those portions of the paper which refer to the purchase and test of the 300° oil, which is alone used for car lighting on the Pennsylvania R. R.

It is probably well known that petroleum, as it comes from the ground, is a mixture of hydrocarbons, which differ from each other, so far as their physical properties go, principally in their boiling points and densities. It is, of course, natural that the attempt to separate these different bodies should be by distillation, and accordingly, so far as we know, the first step in pretty nearly all refining of petroleum, after allowing the oil to settle for a while, is to put it into a still. Heat being applied, of course the constituents of the lower boiling point come off first. In general, we believe the condensed liquid is called "benzine," until the gravity reaches something like 60° or 65° Beaume's scale. Then comes, in general, the 110° fire-test oil, then the 150° fire-test oil, or higher fire-test oil, and still later the 300° fire-test oil. If the distillation is carried far enough, nothing but tar remains in the still. If the distillation is stopped at the proper time, lubricating oil may remain in the still.

All the products of distillation as they come over are more or less contaminated with the heavier parts, and are more or less discolored from the presence of some of the tarry matters, which are either mechanically carried along or pass over in regular distillation. It is customary, we believe, to remove most of the color and tarry matters by treatment with oil of vitriol, which seems to have the power of combining chemically with the tarry matter and precipitating it to the bottom of the tank. Also some of the oils, especially the lubricating oils, are changed in color and improved very much in appearance by filtering through bone black.

The following is the latest revision of the specifications for petroleum products on the Pennsylvania Railroad, dated, as will be observed, September, 1889.

PENNSYLVANIA RAILROAD COMPANY.

Motive Power Department.

Specifications for Petroleum Products.

Five different grades of petroleum products will be used. The materials desired under this specification are the products of the distillation and refining of petroleum unmixed with any other substances and conforming to the detail specifications below. Products having very offensive odor, or being mixed with other oils, will not be accepted. Shipments must be made as soon as possible after the order is received. All shipments received at any place on or after Oct. 1 must show the proper cold test, and all received on or after May 1 must show the proper flash point, and will be rejected if they fail, even though the order did not call for winter and summer oil, respectively, unless it can be shown that the shipments have been more than a week in transit. No preliminary examination of samples will be required, but a limited amount of special preliminary examination will be made on the request of the purchasing agent, for use of parties desiring the information. When a shipment is received, a single sample will be taken at random and subjected to test, and the shipment will be accepted or rejected on this sample. If rejected, it will be returned at the shippers' expense.

The following detail specifications will be enforced:

150° FIRE-TEST OIL.*

This grade of oil will not be accepted if sample:

1. Is not "water white" in color.
2. Flashes below 138° Fahr.
3. Burns below 151° Fahr.
4. Is cloudy, or shipment has cloudy barrels when received, from the presence of glue or suspended matter.
5. Becomes opaque, or shows cloud when the sample has been 10 minutes at a temperature of 0° Fahr.

The flashing and burning points are determined by heating the oil in an open vessel, not less than 12° per minute, and applying the test flame every 7°, beginning at 123° Fahr. The cold test may be conveniently made by having an ounce of the oil in a 4-oz. sample bottle, with a thermometer suspended in the oil, and exposing this to a freezing mixture of ice and salt. It is advisable to stir with the thermometer while the oil is cooling. The oil must remain transparent in the freezing mixture 10 minutes after it has cooled to zero.

300° FIRE TEST OIL.

This grade of oil will not be accepted if sample:

1. Is not "water white" in color.
2. Flashes below 249° Fahr.
3. Burns below 298° Fahr.
4. Is cloudy, or shipment has cloudy barrels when received, from the presence of glue or suspended matter.
5. Becomes opaque, or shows cloud when the sample has been 10 minutes at a temperature of 32° Fahr.

The flashing and burning points are determined the same as for 150° fire-test oil, except that the oil is heated 15° per minute, test flame being applied first at 212° Fahr. The cold test is made the same as above, except that ice and water are used.

With regard to the burning oils we are hardly prepared to say that we think the method of taking the flashing and burning points which we commonly use, and which with more or less modifications is in common use everywhere, gives a perfectly safe oil, although it should be stated that with most lamp constructions which are in common use on railroads, an experience of now nearly 15 years shows that with oils which pass the tests given in the Pennsylvania Railroad specifications, explosions or accidents due to the oil almost never occur. In the two or three cases which have occurred, some peculiarity in the use of the oil accounted for the accident. In one case a lamp was put behind a stove and the temperature of the oil became very high. In another case of headlight oil (150° test) the lamp was so located that heat from the smokebox heated the oil far above any safe limit of temperature.

The explanation of why lamps are in an explosive condition under the circumstances described, is perhaps not at all difficult to comprehend. As has already been described, all the petroleum products are mixtures of hydrocarbons of different boiling points and densities, and the method of separation of these different constituents by distillation makes each resulting product have some of the higher and some of the lower of these constituents. For example, 150° fire-test oil is not exclusively a hydrocarbon which distils at a certain temperature, but a mixture of hydrocarbons of boiling points above and below the temperature corresponding to that at which most of the oil comes over from the still; in other words, ordinary 150° fire-test oil has some light oil in it and some heavier oil in it. This being granted, if the oil stands, as in a lamp half full, the tendency of the lighter parts, especially as the temperature goes up, is to separate from the mass of the oil and become a vapor mixed with the air in the lamp above the oil. If the proportions of air and oil vapor are right, this mixture is an explosive one. However, on the Pennsylvania Railroad no 150° oil even is used where it can have any chance to affect the safety of the passengers, with the bare exception of out-door lamps at small stations for lighting up the platform.

MAKING THE FIRE TESTS.

The apparatus which we make use of is an ordinary small iron cup sand-bath placed above a Bunsen burner, which plays directly against the pan of the sand-bath and heats the sand. In the sand-bath an ordinary porcelain dish, such as are commonly used in chemical laboratories, about 2⅝ in. diameter inside and about 1 in. deep inside, is placed. This is filled to within ¼ in. of the top with the oil to be tested, the amount of oil under test being about one fluid ounce. A thermometer is suspended in about the center of the surface of the oil, so that the bulb is fairly immersed in the oil, but does not touch the bottom of the dish. As a test flame we use a very small gas jet, about as big as the head of flame on the end of a burning string. We usually draw out a glass tube to a fine aperture and allow the gas to pass through this aperture until we get the size of flame mentioned.

In our experience with open-cup testing, the following variables affect the flashing and burning points: First, rate of heating; second, size and depth of the cup used; third, amount of oil used; fourth, the thermometer; fifth, distance of the test flame from the oil; sixth, the size of the test flame; seventh, the length of time the test flame is held above the surface of the oil; eighth, the place where the test flame is held; ninth, how often the test flame is applied, and tenth, surrounding conditions and peculiarities of the apparatus and manipulator.

In view of this large number of variables, it is, perhaps, not surprising that there should be so much discrepancy in the fire-tests made by different parties, nor indeed surprising that duplicate tests out of the same can should not give exactly the same results. In our experience the most important variable is the rate of heating. It is entirely possible to take a sample of oil and get a higher fire-test by from 5° to 10°, by making the rate of heating very slow, over what would be obtained if the rate of heating were more rapid. So important do we regard this variable of rate of heating that we especially specify it in our specifications. It will be observed that for the 150° oil we raise the temperature of the oil not less than 12° a minute, and for all the other oils we raise the temperature not less than 15° per minute.

The size and depth of the cup affect the fire test in this: if the same amount of oil is in a large shallow cup, the dissipation of the oil vapor into the surrounding air is more rapid than if it is in a smaller sized deep cup, and the dissipation of the oil vapor being a function of the flashing and burning points, in is plain to be seen that these two variables would affect the test. Also whether the cup is filled nearly full or partly full affects the fire test.

The amount of oil affects the test, as is plain to be seen, by virtue of the amount of vapor which is generated. With a large amount of oil, the same rate of heating and other variables uniform, a much larger amount of vapor will be generated in the same time than with a small amount of oil. The effect of the larger amount of oil is therefore to make the test a little more severe on the oil.

The thermometer affects the test somewhat more in its unreliability than in any other way, it being a very common experience with thermometers that they are from 1° to 3° out in their readings, and also that a thermometer which has been used for some time, and especially if the same thermometer has been used to make high fire tests as well as low, gives readings which are unreliable. We usually use what are known as the best chemical thermometers, obtainable from the ordinary chemical supply dealers, and discontinue their use after a few months.

The distance of the test flame from the surface of the oil makes quite a difference in the fire test. If the test flame is put down to within ¼ in. of the oil, the flash and burn will be obtained considerably sooner than if the test flame is held ½ in. or ¾ in. above the surface of the oil. This is, of course, readily understood on the hypothesis previously suggested, that the flash and burn are simply mixtures of air and oil vapor, and it is obvious that the mixture of air and oil vapor, especially in the flashing point, would sooner reach the combustible point at ¼ in. above the oil than ¾ in. above the oil. We usually hold the test flame about ¼ in. above the oil.

The size of the test flame has an influence in its effect on the generation of vapor from the oil. A bead of flame one-half as large in diameter as a lead pencil and maybe

* We reprint this paragraph simply because of its relation to the testing of the 300° oil, which is alone used in car lamps.

¼ in. long, will give a different result from a test flame as large as a lead pencil and ¾ in. long. This is especially noticeable in burning point, not so much in flashing point.

The length of time that the test flame is held to the oil also has an influence in the effect of the flame on the oil. This is quite clear, we think, without explanation.

The place on the surface of the oil where the test flame is applied is a matter of considerable importance. If the test flame is held near the edge of the dish, a flash will be obtained at a number of degrees lower temperature than if the flame is adroitly passed down near the thermometer to within ¼ in. of the surface of the oil and as adroitly pulled out again. It is obvious why this should be so. At the edge of the dish the oil vapor and the air have the best chance to mix, while in the center of the dish, near the thermometer, the material may be largely oil vapor.

In our view the place where the test flame is held in open-cup testing is the next most important variable after the rate of heating.

How often the test flame is applied affects the test of a very sensitive oil apparently by the influence of the test flame on the surface of the oil. If the test flame is applied every degree, a considerably lower fire test will be obtained than if the test flame is applied, as is our custom, every 7°. It is plain to be seen that the influence of the heat of a test flame on a very sensitive oil would be considerable.

The surrounding conditions have some influence on the test of an oil, notably, the barometric pressure being quite low, the escape of the vapor from the surface of the oil is more easy than with a higher barometric pressure, and in a very sensitive oil this undoubtedly makes some difference. We had a case once in which we were utterly unable to account for the difference obtained in testing the same sample of oil with the same apparatus and same manipulator on several successive days except by the barometric pressure. Furthermore, currents of air passing over the dish are especially important surrounding conditions. It is very clear why this should be so. If the vapor is carried off by a current of air as fast as it is generated, it is obvious that the fire test will be considerably higher than if the vapor which comes out of the oil is allowed to accumulate over its surface. It is not always pleasant to make fire tests of oils in a closed room, but we are very careful in our work to have no currents of air to assist the dissipation of the oil vapor which is set free from the surface of the oil.

It is a question which has been much discussed among users of the petroleum products whether there was any use in taking anything more than the flashing point, since this really measures the dangerous quality of the oil. We are inclined to think the flashing point is abundant to protect the interests of the railroad company, provided the taking of the flashing point is surrounded with sufficient precautions; but as a means of additional security, and especially as a means of neglecting no precaution that could fairly be made use of to prevent accidents with the burning oils, we still adhere to the burning point as an essential feature. Moreover we have found a few oils the flashing and burning points of which were very close together, and from the nature of the distillation we would expect this would be true of oils which represent a very small fraction of the original petroleum so that taking all things into account, it has been deemed advisable to maintain the burning point likewise as a test for all petroleum products used for burning.

COLOR AND CLEARNESS.

In regard to the remaining tests for petroleum products, the two burning oils are required to be "water-white" in color, and there are not a few among the refiners who think that a yellow oil gives equally good results in burning as "water-white" oil, and we are hardly prepared to dispute the position. The reason for demanding "water white" oil is that by the ordinary method of distillation the oils contain some tarry matter, unless this is removed as has been previously described, by treatment with oil of vitriol; and as the demands made on our burning oils are rather severe, we have felt that we were entitled to all precautions possible to prevent clogging of the wicks, the tar, as is well known, remaining in the wicks and causing them to crust. We accordingly demand "water-white" oil. Many times the market falls a little short of "water-white" oil, and what is known as "prime white" is frequently sent in place of "water white." The distinction is not very sharp, and we are ofttimes compelled to accept material than is somewhat less than "water white."

The question of cloudy oil is a very serious one. The most common cause of cloudy oil is due to the following points in manipulation at the refineries where the oil is barreled. The barrels, in order to make them tight, are treated on the inside with a dilute solution of glue. It sometimes happens that owing to carelessness either the gluey solution is not wholly drained out or the barrel is not allowed to become sufficiently dry before the oil is put in. In this case the gluey matter, owing to the shocks of rolling and shaking incident to loading on cars and transportation, becomes thoroughly mixed up with the oil, giving it an opaque or cloudy appearance, which cloudy appearance is very slow to disappear by settling. These little particles of glue or glue and water finely divided, suspended in the oil, are, when the oil is used for burning, soaked up into the wick, and clog it, as will be readily understood. We have had much difficulty from this cause, and the rule is enforced quite strenuously that cloudy oil will not be received. The sample sent for test being, as the specifications state, a sample from a single barrel chosen at random, and the bad condition of a barrel when it is full being characteristic of of any barrel in the shipment, it does not always happen that the sample which we receive shows a cloudy appearance, although other barrels in the shipment may do so. To obviate this difficulty, the instructions to the men at the oil-houses are that all barrels containing cloudy oil must be returned to the shippers, they themselves performing the inspection necessary to determine this point. Long standing in a quiet position will cause most of this material to precipitate, but the supply carried at most of the oil-houses demands that the oil be used moderately quickly after it is received, and consequently we have preferred to return cloudy oil rather than attempt to use it.

Mr. W. B. D. PENNIMAN, Chief Chemist of the Baltimore & Ohio R. R., furnishes us the following information concerning the testing of burning oils on that road: The specifications now in force on the Baltimore & Ohio are as follows:

CONDITIONS OF SHIPMENT AND AND GENERAL SPECIFICATIONS.

The material will be purchased by weight. Barrels must be in good condition and must have the name of the contents and the consignee's name and address on each barrel, and plainly marked with the gross and net weight which will be subject to the company's weight.

When received all shipments will be promptly weighed. If not practicable to empty all barrels, 10% will be emptied, and the losses of the whole shipment will be adjusted in accordance with the 10% taken. Should the net weight thus obtained be less by 1% than the amount charged in the bill, a reduction will be made for all over 1%.

Prices should be given in cents or hundredths of a cent per pound.

Shipments, one or more barrels of which are filled with oil cloudy from the presence of glue, or which contain dirt, water or other impurities, will be rejected.

Two kinds of petroleum burning oils will be used, known as 150° fire test for general use, and 300° fire test for use in passenger cars.

DETAIL SPECIFICATIONS.

150° *Fire Test Oil.*—This oil must conform to the following requirements:

1. It must have a flash test above 125° Fahr.
2. It must have a fire test not below 150° Fahr.
3. It must have a cloud test not above 0° Fahr.
4. It must be a "Water White" in color.
5. Its gravity must be between 44° and 48° B. at 60° Fahr.

300° *Fire Test Oil.*—This oil must conform to the following requirements:

1. It must have a flash test above 250° Fahr.
2. It must have a fire test not below 300° Fahr.
3. It must have a cloud test not above 32° Fahr.
4. It must be a "Standard White" in color.
5. Its gravity must be between 38° and 42° B. at 60° Fahr.

METHOD OF MAKING TESTS.

150° *Fire Test Oil.*—The "Open Tagliabue" cup is used for determining the flashing and burning points of this oil; heating the oil at the rate of 2° Fahr. per minute, and applying the test flame every degree from 120° for flash and every 4° after flash for the burning point.

300° *Fire Test Oil.*—The "Cleveland" cup is used for determining the flashing and burning points of this oil, heating at the rate of 5° per minute, and applying the test flame every 5° from 230° Fahr.

CLOUD TEST.

The cloud test is made as follows: Two ounces of the oil are placed in a 4-oz. sample bottle, with a thermometer suspended in the oil. The bottle is exposed to a freezing mixture of ice and salt, and the oil stirred with the thermometer while cooling. The temperature at which the cloud forms is taken as the cloud test.

Mr. PENNIMAN's experience with regard to the color of oil has been that it is useless, if not practically impossible, to get a water white 300° oil. He has frequently made comparative tests of water white oil and oil that was slightly off color, and the results have shown that the quality of the oil was much more dependent upon the gravity and the cold test than upon any other conditions. All of these oils are such complex mixtures of hydro-carbon that oils are often obtained of the same color, same cold test, fire and flash, which give different results in burning. The cold test of 300° oil is, next to gravity, the most important point to be considered; and it is necessary to enforce this requirement strictly throughout the winter.

Accidents on Cable and Electric Railways in St. Louis.

The increase in street railway accidents with the general introduction of electric and cable traction in place of horses has been commented on several times of late in these columns, but it is a matter which is little realized yet by the general public. A correspondent, Mr. JOHN A. BOHLAND, of St. Louis, Mo., calls our attention to a recent number of the St. Louis *Post-Dispatch*, which gives a complete list of the accidents due to cable, electric and motor cars on street railways, from Jan. 1 to Sept. 1 of the current year.

According to Poor's Directory, just out, the total extent of cable railways in St. Louis is 42 miles, and the total extent of electric railways is 116 miles. We condense the record as follows:

Jan. 2. Electric car struck wagon. Driver run over; badly injured.
4. Electric car struck and demolished wagon.
4. Electric car knocked down pedestrian and broke his arm.
6. Cable car struck and demolished wagon. Driver injured.
14. Collision between electric and horse car. Passenger injured.
20. Boy run over and killed by steam motor train.
20. Passenger injured in attempting to board cable car.
21. Electric car knocked down and injured pedestrian.
22. Electric car knocked down and bruised a boy.
24. Electric car knocked down and killed a boy.
24. Horse car knocked down and crushed leg of pedestrian.

Feb. 2. Horse frightened by electric car. Driver injured.
3. Woman fell from electric car, badly bruised.
5. Pedestrian crushed and killed between two electric cars.
5. Cable car knocked down and bruised pedestrian.
11. Cable car struck and demolished milk wagon.
14. Women fell from cable car. Badly injured.
16. Electric car ran over and killed 4-year-old boy.
17. Passenger fell from electric car, badly bruised.
17. Motorman knocked senseless by striking head against trolley wire poles between trucks.
18. Pedestrian run down by cable car. Arm lacerated.
19. Pedestrian knocked down and bruised by electric car.
21. Furniture wagon wrecked by electric car.
25. Passenger fell from electric car and was injured.
28. Electric car struck and demolished wagon.

March 1. Boy knocked down and hip crushed by cable train.
10. Boy struck by cable car, arm hurt.
12. Passenger fell from horse car and broke thigh.
12. Electric car struck wagon. Driver injured.
12. Electric car struck carriage. Two men injured.
12. Cable car struck and damaged wagon.
18. Electric car struck and damaged wagon.
23. Electric car struck wagon. Driver seriously injured.
25. Collision between two electric cars. Both conductors injured.

April 1. Three men injured, one in attempting to board cable car, one by falling from cable car, one by collision with electric car.
4. Cable car struck carriage and injured driver.
4. Horse struck and killed by electric car.
11. Pedestrian run down and killed by cable car.
11. Passenger fell from cable car and was injured.
11. Electric car collided with and damaged ambulance.
21. Electric car collided with and damaged wagon.
22. Cable car struck dirt wagon. Driver injured.
22. Pedestrian run over and injured by electric car.
22. Cable car struck wagon. Driver injured.
30. Passenger fell from cable car and dislocated shoulder.

May 2. Boy run over and fatally injured by electric car.
2. Passenger fell from cable car, badly bruised.
6. Pedestrian run down and injured by cable car.
13. Boy fell under electric car. Fatally injured.
13. Woman knocked down and bruised by cable car.
13. Passenger fell from electric car and was bruised.
30. Boy run down and killed by electric car.
30. Cable car collided with surrey. Both demolished.

June 8. Cable car struck buggy, injuring driver.
10. Pedestrian knocked down and seriously injured by electric car.
14. Pedestrian struck and fatally injured by cable car.
14. Passenger fell from cable car and was injured.
14. Passenger received small scalp wound by falling from cable car.
15. Electric car struck buggy. Driver severely injured.
17. Electric car struck wagon. Driver severely injured.
17. Passenger fell and was injured in attempting to board cable car.
17. Two horses killed by current from trolley wire.
27. Passenger fell under cable car and was fatally injured in attempting to board it.
29. Pedestrian killed by cable car.

July 1. Pedestrian injured by cable car.
2. Electric car struck and damaged express wagon
4. Pedestrian had leg crushed by cable car.
11. Cable car struck wagon. Driver injured.
14. Passenger fell from cable car and was injured.
15. Passenger fell from cable car and broke his leg.
17. Woman run over by electric car.
18. Pedestrian had leg crushed by cable car.
18. Cable car struck carriage. Two occupants injured.
18. Cable car struck wagon.
27. Passenger fell from cable car. Fatally injured.

Aug. 1. Passenger fell from cable car and broke leg.
3. Passenger fell from cable car and was bruised.
3. Boy fell under cable car and was killed.
8. Cable car struck and demolished wagon.
8. Electric car struck carriage and injured two occupants.
17. Passenger fell from electric car. Leg badly cut.
18. Two horses struck and killed by cable car.

Aug. 18. Electric car struck buggy and injured driver.
27. Woman knocked down and injured by cable car.
30. Messenger boy crushed and killed by electric car.
31. Woman fell from cable car. Severely bruised.

Classifying the different accidents by their causes, we find that in 32 cases pedestrians in the street were struck by the car. In over one-third of these cases the victims were either killed or fatally injured. Vehicles were struck by the cars in 28 cases, and there were two collisions. There were 23 cases where persons suffered harm in getting off or on cars or by falling from them. The total casualties during the 8 months were 19 passengers injured and one killed, while 41 others were injured and 13 were killed.

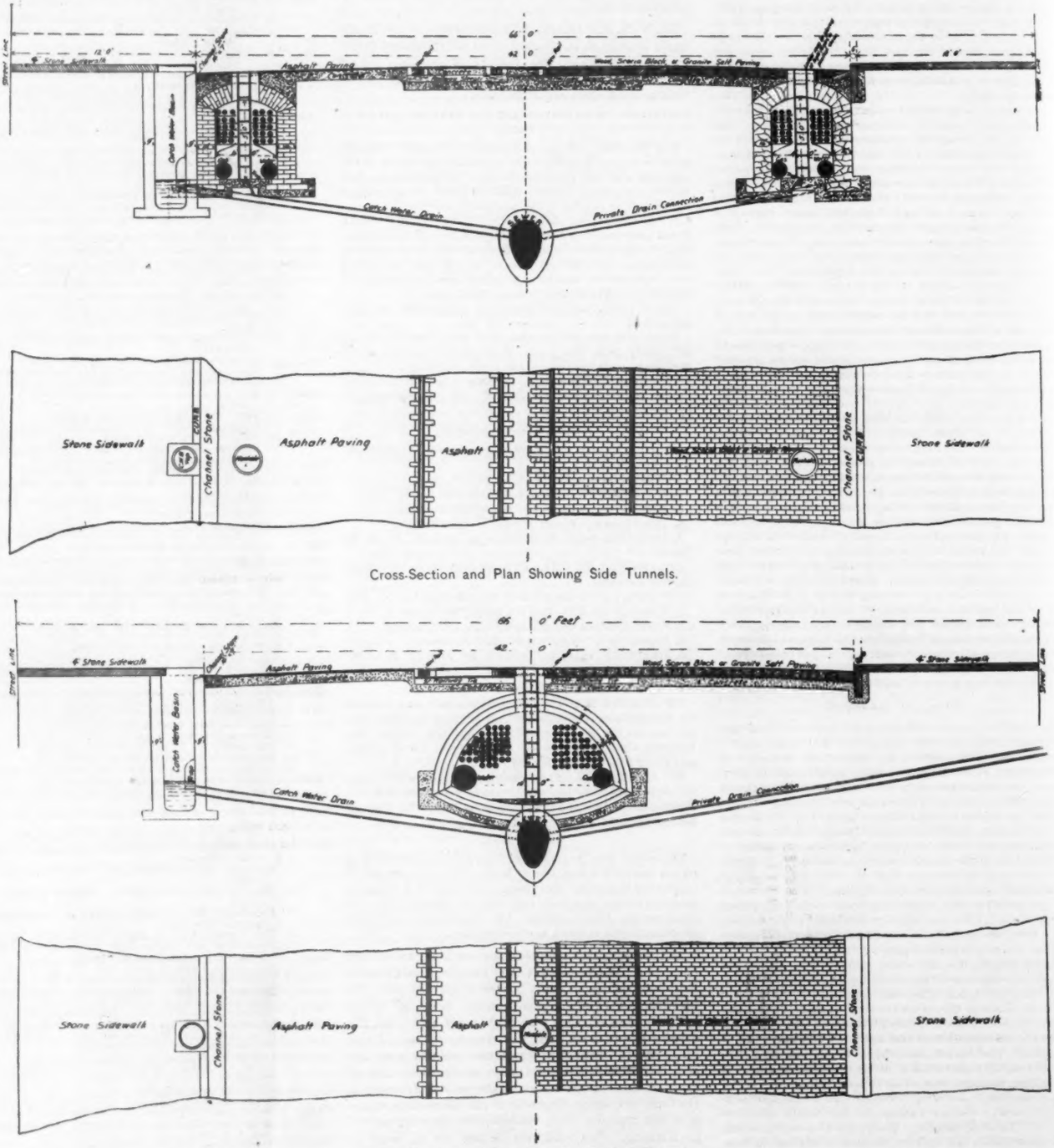
If a single city in eight months can show such a record of deaths and injuries, the total annual casualties on all the street railways of the country must mount far toward that recorded for ordinary railway lines, if indeed it does not exceed it. The most noteworthy fact, however, is that all but two of these accidents occurred on cable or electric lines. Whether the accidents on horse roads (of which St. Louis still has 65 miles) were reported with equal care we do not know, but it seems likely that they were not. In any case, however, the showing of the danger from running high speed cars in city streets is a most striking one

Proposed Toronto Subways for Wires, Etc.

In the report for 1890 of City Engineer W. T. JENNINGS, of Toronto, Canada, he presents two forms of subways for water and gas pipes, wires, etc., as proposed by him. These plans are presented in connection with a report to the Committee on Works on the permanent paving of Yonge, King and Queen streets, in that city.

Mr. JENNINGS submits with these plans a list of 11 types of street paving and their cost per sq. yd. These prices range from Belgian pavement on 6 ins. of concrete, at $4.30 per sq. yd., to 7-in. round-cedar block paving on 8 ins. of gravel, at $1 per sq. yd. These tables are interesting and we may give them in full later, but for the present confine ourselves to illustrating what the city engineer deems essential, the preservation of an unbroken surface, for any good pavement.

The two plans shown are alternative plans, to be used over a length of 5,100 ft., if adopted by the authorities. The arguments advanced in their favor are unassailable, and include better sanitary con-



Cross-Section and Plan Showing Side Tunnels.

Cross-Section and Plan Showing Central Tunnel.

PROPOSED SUBWAY AND STREET CONSTRUCTION AT TORONTO, CANADA. W. F. Jennings, City Engineer.

ditions and better draining and cleaning as resulting from the permanence of an asphalt pavement laid on concrete and not subjected to cutting for pipes, wires and connections.

Mr. JENNINGS does not append an estimate of cost, but he thinks an annual revenue per mile could be collected from the companies using the street car tracks that would make at least the central portion free of cost to the city. The tunnels would be built of stone and brick, and large enough for a man to pass through them for connections and repairs. He does not deny that they would be costly, but without some device of this kind continuous, comfortable and entire use of a well-paved street can not be secured. He naturally prefers the two tunnels next the curbs, as being the easiest to connect with.

Railway Surveys and Resurveys.

BY HOSEA PAUL, CHIEF ENGINEER TOLEDO & WESTERN RAILWAY.

(*Continued from p. 255.*)

To show the comprehensive nature of the information returned in the field books, and nearly all exhibited in the plans and profiles, it might be well to state that it embraced a graphic representation, with full dimensions, plusses, distance out from the track in regard to the following points: Stations, freight, passenger and combination; alinement, curvature and deflections; platforms, passenger, loading and transfer; side tracks, passing tracks, spur tracks, Ys, connecting, loading and unloading tracks; switches and frogs; scales, elevators, warehouses and factories; corn cribs and coal bins; semaphores, targets and watchmen's houses; section-houses and tool chests; mile posts, section posts, crossing whistle posts, warning posts, station whistle posts, yard limits posts, clearance posts, slow posts and stop posts; cattle guards and cattle passes; water tanks, tubs, wells and engine and pump houses; wooden box culverts, iron pipe culverts, sewer pipe and tile culverts; framed trestle and pile bridges; stone base and arch culverts; Howe truss and other wood bridges; plate girder and trussed iron bridges, etc., embracing every detail of alinement, surface, topography, structure, nature of title and claim of ownership; the details of shops, yards, terminals, crossings and connections, with civil boundaries, government divisions, etc., to an extent not necessary to further enumerate.

It was a veritable photograph, a living picture of the line. There were shortcomings and some few errors, mainly of omission, but once available for use these were lost sight of in the fullness of detail and the uniform accuracy, and in the comprehensive scope of the work as a whole its completion was a landmark in the history of the company, a standard to which all matters pertaining to its physical life must be ever referred.

I am not fully prepared to state the cost in detail or give exact figures, but can estimate somewhat closely. The rate of progress was, for the staking party, somewhat over four miles per day. The level and transit parties would make from one to one and a half miles per day each.

Performed in a similar manner I would estimate the cost of a resurvey of not less than 300 miles somewhat as follows:

Estimate per Mile.

Staking party	$1.75 to $2.00
Levels and topography	5.00 " 7.50
Transit party	5.50 " 8.50
Platting	7.50 " 12.00
Searching records, etc.	1.50 " 3.00
Materials, stakes, drawing supplies, etc.	3.00 " 4.00
Supervision and sundries	1.00 " 3.00
	$25.25 to $40.00

Some miles in the open country did not cost over $10 to $15 each, while $100 would sometimes be insufficient to pay the cost of a like distance in a city.

As to the practical use and benefit of a resurvey of this kind, extended illustration is certainly not needed. Many of the uses that will be made are these—because it affords accurate, detailed information, clearly presented and in a form that can be consulted in a moment, and will be so consulted hundreds of times where, if the information were not accessible in this form, important interests would suffer because of trouble, delay and expense in obtaining such information specially. In cases of wrecks and accidents it will be found invaluable.

Without undertaking to enumerate all its uses, or even to specify the more important of them. I might mention two uses to which my attention was specially called on several occasions. The first of these was relating to that common occurrence where streets and roads, especially in town plats, were laid out up to the railway company's land and then resumed again on the opposite side, without any attempt being made to acquire title from the company. In the course of a very short time it will generally be found that, by the negligence of the company's officers, a crossing has been put in and eventually, without going to the trouble of paying, purchasing or condemning, but by the mere fact of occupation and use, the public has acquired a definite right to such crossing and, very possibly, be demanding gates and watchmen therefor. The second class of cases needing careful scrutiny was that resulting from the numerous instances where parties owning elevators, coal yards, saw and grist mills, warehouses, etc., were permitted to set their buildings and fences in whole or in part on the company's lands, mainly for convenience in receiving and shipping freight of a bulky character.

The extent of such encroachment and use of valuable ground is much larger than generally supposed, and how most of them come to be there, and how to get rid of them, in case the ground might be needed for other uses, constitutes a problem that is not always easily answered. The most practical solution is usually to force such parties to take out a short term lease, and requiring an annual or quarterly payment, the sum being possibly merely a nominal one, but the exaction and payment of which will constitute a recognition of the company's title. With people dealing with the company, and expecting favors in the way of rates, shipments, etc., such arrangements are easily made; but where the property has been diverted to other uses, or where by reason of competition of other roads they are independent and insist upon their rights, the company may find that it has lost the land altogether. Such encroachments are usually of such insidious character that ordinary methods fail to reveal them.

Perhaps, however, the first use was for statistical and taxation purposes. There was immediate need of information in regard to distances and mileage between stations, etc., for fixing rates and for divisions of earnings with other companies, and for the purposes of taxation, that there might be assigned to each borough or municipal corporation, township, county and state its relative proportion of track. To the compilers of such statistics the resurvey was a great and welcome relief, and gave for the first time completeness, character and accuracy.

The scientific possibilities of such a survey are worth a little attention. I am aware that the exigencies of railway service offer little time, and possibly tend to destroy all taste for nice results. The prizes seem to be for the plodding, the persistent, the possessors of influence, rather than for those who study out improvements or who dare to dream of anything besides common place routine. But there are some things that are fairly within reach in a comprehensive resurvey. The first of these is a somewhat accurate determination of length.

An ordinary steel tape used on a track of course gives results far beyond that of the chain used by the locating surveyors on uneven ground, and with many obstructions. But a steel tape is no longer the special tool of the surveyor. It is used by carpenters, stone masons, well drillers, plumbers, coopers, carpet layers and other artisans. The science of measuring is advancing, and the surveyor whose lines are a thousand or a million times as long as the lines measured by the artisan must be careful not to continually repeat and multiply those small errors they may safely neglect. He must not think of using a steel tape without carefully calibrating the same; without taking careful note of length, strain, temperature and methods of suspension or support. Otherwise he may easily make errors of three, five or even more feet to the mile; errors in great part inexcusable because their substantial eradication is a question of professional skill rather than involving any considerable increase of time, labor or expense.

The monuments set along the line ought therefore to represent such absolute distances as would command the highest confidence of the best class of land and city surveyors, and such that a disagreement would involve a distrust of their own most careful work.

In like manner the elevation of bench marks, etc., ought to be so absolute as to accuracy as to serve as starting points. Such elevations ought to be furnished to county and city surveyors, as a basis for the more general use of sea level datum. No company will lose anything by the offer and interchange of such information. The equivalent length of fore and back sights possible where a regular surface is marked off eliminates most of the ordinary sources of error, and the extent of the work permits somewhat better instruments and superior methods. As to the direction, the ordinary processes are not scientifically complete. There is an accumulation of small angular errors, due to imperfect measurements, each possibly small in itself, yet of appreciable moment in long distances. Some small deflections, especially in long tangents, may escape notice altogether. The check of taking magnetic bearings at intervals that is usually suggested is scarcely worth consideration in this connection. It involves the trouble of setting off a new line at a distance from the track or other source of magnetic attraction, and the check can rarely be depended upon to within five minutes, and with the expertness and accuracy of a transitman in a high stage of training who observes angles to half minutes or less, it seems hardly worth the trouble however it may be to a transitman somewhat out of practice. Then there is to be considered the question of the curvature of the earth, and its effect on so-called straight lines or tangents. All this suggests occasional determinations of the true meridian and a reduction of angles to polar azimuths.

Aside from its general results one of the most suggestive things in connection with a resurvey is the field it offers for and the economy and the results possibly to be obtained by organization, regularly defined duties and special skill. Even the inexperienced soon acquire great proficiency, speed and accuracy. But it should not, therefore, be intrusted to amateurs or as an occasional duty, or be strung out over a long period. The direct management and the execution of the work should be in the hands of men specially employed or detailed, who have had, if possible, some previous experience in similar lines of work, and who should not be interrupted by other duties. Especial care should be taken to finish up the work and make available its results as it progresses, not only to justify as early as possible a reason for its being, but that those changes and improvements which may suggest themselves may be early incorporated.

One more practical suggestion that arises is as to the designating of bridges by number. The common practice is to begin at one end of the line and number them progressively. The trouble is one has to keep a list to know where they are, and the system is rarely elastic enough to admit of the inevitable necessity for numbers for new structures put in, or to easily dispose of the numbers assigned to those abandoned. I would suggest instead that each bridge be first designated by the mile post and then by letter. In this way Bridge 123 A would signify the first bridge beyond mile post No. 123 and 123 B, the second bridge, and these letters might continue until the next mile post was reached, as plusses are counted from a regular station. The system would therefore be flexible enough to admit of changes, and have the great advantage of suggesting locality. The resurvey specially referred to as a basis of these remarks was that of the Lake Erie & Western Railroad. The work was begun in the summer of 1888 and occupied something over two years. Credit is due to the President, Hon. CALVIN S. BRICE, to the General Manager, Col. GEO. L. BRADBURY, and T. H. PERRY, Chief Engineer, for their realization of the need and appreciation of the result of such resurvey. Those immediately concerned in its execution and who were, therefore, specially identified with it were, in addition to the writer, Geo. WHITFIELD CHANCE, W. F. GOLTRA, J. H. PIRKEY, J. C. WAGNER, T. NELSON SPENCER, W. C. FURBER, WM. H. BUTT, CHARLES S. BUTT, J. C. KUELLING, J. W. WEAVER, and others whose term of service was generally shorter or not known to the writer. All of these mentioned were men of either large experience or technical training or both. Messrs. CHANCE,

WAGNER and SPENCER have since been employed in similar work on the Norfolk & Western R. R.

Something analogous to resurvey methods was undertaken some years ago on the then Atlantic & Great Western Railway, later known as the New York, Pennsylvania & Ohio, and now forming a part of the New York, Lake Erie & Western, by the late CHARLES LATIMER, Chief Engineer. The first work was immediately upon his appointment some time about 1873, when he caused new profiles and maps of the road to be made. These maps differed from those described in the L. E. & W., at Indianapolis, by not having the description and abstract of the conveyance written directly on the map itself, but by a somewhat shorter abstract on another sheet facing the band, and bound so as to be interleaved with the maps.

At a later period, about 1883, when the railway was finally turned over to the Erie system, the maps and profiles in the Cleveland office were revised and tracings and duplicates made for the general offices at New York. About this later time Mr. LATIMER caused special condensed profiles to be made up, which showed not only the features of grades and alinement but also the leading physical characteristics of the line, bridges, culverts, crossings, targets, etc., and in the margin was shown plans of station grounds, buildings, terminals, yards and sidings. The most remarkable and noteworthy thing about these was not so much the fact of their being prepared, but because they were lithographed and virtually published for distribution among superintendents, trainmasters, master mechanics, dispatchers, roadmasters, as well as civil engineers, thus placing such information within the reach of all who might be interested, instead of being something deposited in the archives of the engineer's office, and only available for occasional use. In like manner the deeds of the company's lands were printed and bound up in to a volume for distribution and similar use.

Still further, another set of maps was prepared showing the line through each county, and sent thither for record, even though there was no legal requirement for such record. This was a very great convenience to the public, and an example of a very different practice than that followed by many railway officials who affect an air of great secrecy and mystery about the simplest matters, and will scarcely permit an outsider to look at their maps or titles. As, however, railways are semi-public corporations and not only have duties to perform toward the public, but very frequently favors to ask, it may well be questioned if any concealment of this sort is of more real advantage than dealing with the public in that frank and open way which characterized every act of one of the great civil engineers of his time.

The Pennsylvania and other great systems, especially those undertaking to improve grades and alinement, have by reason of such changes a loss and gain of length, which makes a continual shifting of stations, stakes and mile posts necessary, if absolute distances are preserved. The safer way it seems to me would be not to be too hasty in moving them for every slight change, but reserving them until they increase to such a considerable number that they are not easily kept track of.

Four-inch Drains versus Six-inch Drains.*

It is a matter of every-day occurrence to find a 6-inch pipe used for the drainage of a single house, and this size is usually made compulsory by sanitary authorities, whether metropolitan, urban or rural

As a house drain is frequently dry for several hours at a time, it is obvious that where pipes of this diameter are used there must be a considerable extent of surface on which sediment is deposited, and as a natural consequence, during the periods of minimum flow this deposit will decompose and foul gases will be generated. If the house drain is properly disconnected from the main sewer, and efficiently ventilated, a large proportion of these gases will undoubtedly be carried off and liberated in the atmosphere, but the tendency of the remainder will be to move in the direction of the house by reason of the absorptive influence of the warmer air within.

The author contends that this generation of gases in the house-drain, apart from its being adverse to the principles of sanitation, is preventable, the remedy lying in the use of smaller pipes. Taking as an example the case of an ordinary sized town house, with an average of 10 inhabitants, and allowing 30 galls. of waste water or liquid matter to be discharged per head per day, the total volume would be 300 galls. per day, and of this amount at least one-half must be reckoned as being discharged in 6 hours, this giving 25 galls. per hour as the maximum flow to be provided for. To this amount must be added the rainfall from the roof and areas which, as a rule in the case of town houses, is taken into the sewer. The superficial area to be dealt with under this heading varies from 1,000 to 10,000 sq. ft.; taking 6,000 sq. ft., which is considerably in excess of the average, and allowing for 1¼ ins. of rainfall per hour (thus providing for the heaviest thunderstorms), the total volume of rainfall to be dealt with would be 3,900 galls. per hour. The maximum hourly discharge of sewage and rainfall combined would therefore be 3,925 galls., or 65.4 galls. per minute, and a 4-in. pipe will discharge this amount when running full at the very flat gradient of 1 in 207.36, the velocity produced being 2.02 ft. per second, which is barely sufficient to make a drain self cleansing.

As the conditions on which these figures are based are only likely to occur once or twice a year, if at all (*i. e.*, during an exceptionally severe thunderstorm), it is evident that without special arrangements for flushing, even a 4-in. drain can scarcely be made absolutely self cleansing, more particularly as the usual gradient is from 1 in 40 to 1 in 60, with a consequent increase of discharging capacity.

The author therefore considers that under ordinary circumstances a 4-in. drain is ample for an average sized house, and that a 6-in. drain is too large to be kept free from deposit, more particularly as the majority of the pipes discharging into it are 3 ins. or less in diameter. Baths, lavatories and sinks never have waste pipes exceeding 2 ins. internal diameter, and it is the exception to find more than one appliance being discharged at a time. The question therefore naturally arises "How can a 2-in. pipe possibly flush and cleanse a pipe nine times its own sectional area?"

The soil pipe is the only pipe of larger size which ever discharges at full bore, and the amount discharged at one time (2 or 3 galls. at the most) is insufficient to make a 4-in. horizontal drain run even half full for more than a few feet.

Automatic flushing is of the greatest assistance in keeping a drain free from deposit, and should be adopted in all cases where possible, and more particularly in cases where, from the depth of the main sewer, the inclination of the house drain exceeds 1 in 60.

A tank containing not less than 30 galls. is sufficient to cleanse a 4-in. drain by means of a 2-in. syphon and flushing pipe, and it should be placed at the extreme end or head of the drain, at least 6 ft. above the latter point.

The author maintains that by using a 4-in. drain laid at a uniform inclination not exceeding 1 in 60, aided by automatic flushing, all refuse and other matters discharged into it will be removed in the shortest time and with the minimum of deposit, and those who say that a 4-in. drain would be choked by such extraneous objects as a duster, a medicine bottle, or a hair brush, the saying, "a place for everything and everything in its place" may be aptly quoted, as a house drain cannot obviously be the proper place for a hair brush, and the removal of such articles can be effectually provided for by making every length of drain accessible from inspection chambers.

Another argument in favor of the 4-in. pipe is the increased circulation of air in the drain, as by diminishing the sectional area of the passage the velocity of the air current is considerably accelerated; the volume of air which has to be set in motion in order to produce circulation in a 6-in. pipe being more than double (2.24 times) the volume in a 4-in. pipe.

Gases generated in a 4-in. drain would certainly be carried away more quickly than in a 6-in. drain, apart from the fact previously stated that the possibility of a creation of such gases in a 4-in. drain is reduced to a minimum, while in a 6-in. drain their existence is an absolute certainty.

To summarize briefly, the objection to a 6 in. drain is the fact that deposits must be formed from which noxious gases are generated, with the probability of contaminating the air in the house, while the advantages of a 4-in. drain are:

(1.) Deposit is reduced to a minimum;

(2.) Its size is ample for the discharge of the greatest amount of waste and rain water that can possibly pass into it;

(3.) When combined with automatic flushing at regular intervals, absolute cleansing is obtained; and

(4.) The increased strength of the air currents and the consequential more effectual and rapid purification of the drain.

The author would therefore, in conclusion, urge on all sanitary authorities the advisability of reducing the sizes of house drains as laid down in the existing by-laws and regulations, for while they all endeavor to exclude sewer gas from house drains by means of disconnection and ventilation, the question of its generation in the drains themselves has apparently been hitherto overlooked.

*By G. M. LAWFORD, Assoc. M. Inst. C. E.—Read before the Congress of Hygiene and Demography.

The Chinese and the Mariner's Compass.

A contributor to the North China *Herald*, of Shanghai, discusses in a learned article the claim of the Chinese to the discovery of the magnetic needle. He says the Chinese have great tracts of ironstone and of these no small portion is magnetic. Every woman uses a needle, and those of iron supplanted those of stone commonly used before the time of CH'IN SHIH-HUANG, or about 21 centuries ago. When a needle happened to be made of magnetic iron, its peculiar properties might have been revealed by its accidental fall into water, say with a splint of wood attached. It doubtless came to be known in some such way that needles made of certain kinds of iron were magnetic.

The great producing center of magnetic iron is T'szchou, in southern Chihli. This city was early called the City of Mercy, and the magnetic stone coming from there was known as the Stone of T'szchou, and so *t'szshih* came to be the ordinary name for a magnet. Later the Chinese came to speak of the City of the Magnet, instead of calling it the City of Mercy.

The earliest author who mentions the "south pointing needle," lived in the fourth century B. C., and there can be no doubt but that the polarity of the needle was known at that time, though when, where, and by whom first discovered is not now known. It was, however, not turned to practical use until the Tsai dynasty, when landscapes began to be studied by the professors of geomancy. The belief was general then that this needle had magical powers. KWO PU, the founder of this system of geomancy, died A. D. 324, and it was not until four centuries later that the peculiar compass used in this art began to assume its present form.

The geomancer's compass of the 8th century was made of hard wood, about 1 ft. wide, and had in its center a small well in which a magnetized needle floated in water. On the compass were inscribed several concentric circles which embraced the 12 double hours, the 10 denary symbols, 8 diagrams and other marks. This compass was used in preparing a geomantic report of any spot where a house or tomb was to be constructed, so that the construction might not be an unlucky site or planned in an unlucky manner. At the same time there was living a Chinese who had studied Hindoo astronomy, and was the imperial astronomer, and also a Buddhist priest. He noticed that the needle did not point exactly north, and that there was a variation of 2° 95'. This variation went on increasing till a century later—that is, till the ninth century. A professor of geomancy then added a new circle to the compass. On this improved compass the first of the twelve hours begins on the new circle at 7½° east of north.

The compass, it will be observed, grew out of the old astrological report or nativity paper, calculated from the position of the stars, and prepared in the Han dynasty by astrologers as a regular part of social life, especially when marriages were about to be solemnized. Some of the old astronomical circles are preserved in the new geomantic chart. This was the compass used when SHENKWA wrote on the southpointing needle in the 11th century. This author mentions that any iron needle acquires polarity by rubbing it on a piece of lodestone. He alludes to the variation as a fact which he himself had observed, and speaks of the southpointing needle as an implement used by the professors of geomancy. By them it was employed in the form of a float upon water. After this, in 1122, an ambassador to Corea describes the use of the floating needle on board the ship in which he made the voyage. This is the first instance, the earliest by more than a century, of the use of the mariner's compass on board ship, found as yet in any book, native or foreign. The existence of the book in which this is recorded settles the question of the first use of the mariner's compass at sea in favor of the Chinese. At that time the needle floated on water supported on a piece of wood, but in the Ming dynasty some Japanese junks engaged in piracy were captured by the Chinese, and the compass in use on board was found to have the needle dry and raised on a pivot, while still pointing southward. The Japanese had learned from the Portuguese navigators to make a compass of this kind, and probably the needles they used were brought from Europe. From this time the Chinese adopted the principle of a pivot, and made

their compasses without a well of water in the middle to float the needle in. Charts were probably used of a very rough kind, but how far is not known. What is known is that the junk-master was aware of the direction in which the needle must point to reach the port to which he was going. In the Sung dynasty, embracing part of the 10th, as well as the 11th, 12th, and part of the 13th centuries, Chinese junks went to Persia and India. The Arabs trading to China directly would learn at that time the use of the compass, and would apply it on board their dhows. From them the Europeans learned of this useful invention.

The credit of the discovery, both of the polarity of a magnetized needle and its suitability for use by mariners at sea, must, therefore, according to the writer, be given to the Chinese, says *Nature*, in commenting on the article. It is China also that has the credit of having first noticed that any iron needle may be polarized by rubbing it with a magnet. In the 13th century the Arabs used a floating compass on their dhows. The needle was made to float on the water by attaching it crosswise to a cornstick or splinter of wood. A magnet applied to it drew it into a north and south direction. They would use Western notation to mark the quarters and intermediate points on the horizon. When, therefore, the mariner's compass was adopted from them, the Chinese 24 points were not communicated. In the European compass the notation of 32 points is Western, and rests on the winds and the sun. In the Chinese primitive mariner's compass the notation is that of the professors of geomancy, and rests on the old astrological division of the horizon into twelve double hours. From the Arab account we learn, what the Chinese accounts do not tell us, that the Chinese floated the needle by inserting it in a splinter of wood.

Tests of Samples of Paving Materials.

The following table represents the results of a series of tests of paving materials made under the supervision of Mr. J. HERBERT SHEDD, City Engineer of Providence, R. I. The tests were made between July 23 and Sept. 2, 1891.

Test No. 1 for absorption was made after the samples had been in the rattler 3 hours. The dimensions of the rattler, inside, were as follows: Middle diam., 15¾ ins.; end diam., 14¾ ins.; length, 24 ins. The first test in the rattler was made July 31. All the samples, 124 lbs. 4⅝ oz., of brick and granite were put in alone for the first 2 hours, making the rattler about two-thirds full. The rattler made 55 revolutions per minute. The samples were examined at the end of the first 15 minutes; all had edges rounded; "C" bricks were chipped badly, and "B" bricks slightly. One of the slats of the rattler broke at the half hour. The samples were then again examined; all were in the same comparative condition except the third "D," which had a large piece broken off at one end. This piece was put in with the rest for the remainder of the test. For the third hour, and third "D," which were broken when received. The samples which showed the lowest percentage of loss in the third hour were the first "C," 0.91%, and the first "A," 0.80%. for the brick; and the first "Westerly" 0.49%, for the granite samples.

The second test in the rattler was made Sept. 2. All the samples were put in with 50½ lbs. of broken cast iron and rattled for three hours. The largest piece of iron weighed 8 lbs. 15¼ oz.; the smallest 1 lb. 6½ oz. The rattler made 53 revolutions per minute. The iron lost in the three hours 2.97% of its weight. The only brick samples which lost, in the same time, a smaller percentage of their weight, were the first "C," 2.16%; second and third "B," 1.8% and 2.11%, and the first "A," 2.33%. All the granite samples lost a smaller percentage of their weight than the iron, the lowest being the first "Westerly," 1.48%. The penetration by oil was from an equal and measured amount of kerosene oil applied in the same manner to each sample.

"A," Nos. 3 and 4. Small piece chipped off one end of both bricks in fifth hour in rattler.

"A," Nos. 5 and 6. These bricks were made for the under course in paving.

"B," No. 3. A piece broke off one end in the third hour in rattler.

"D," Nos. 2 and 3. One end was broken off both bricks when received. The broken pieces were removed for the abrasion test.

Details of other tests of paving brick will be found in ENGINEERING NEWS, June 21 and 28, 1890, and April 11, 1891.

AN IMPROVED TYPE OF RAILWAY CAR is said to have been adopted for the Danish State Railways. It consists of 1 first class, 3 second class and 5 third class compartments, with a brake and baggage compartment also. The car is carried on 2 four-wheel trucks, and each truck has an arrangement of plate and spiral springs. The car will be lighted by electricity.

PETROLEUM FUEL FOR LOCOMOTIVES is being experimented with on the Lima & Oroya Ry., in Peru. Two engines built by the Rogers Locomotive Works, of Paterson, N. J., have been fitted with the necessary apparatus, and the average consumption is said to be 38.55 lbs. oil per train mile, as compared with 79.3 lbs. of coal. The oil is not crude petroleum, but a residuum oil with a fire test of about 300° F. It is stated that the results have been so satisfactory that all the engines of the road are to be fitted for burning this fuel.

COMPRESSED AIR FOR THE TRANSMISSION OF POWER is to be tried at Offenbach-on-Main, according to *Industries*, London. The laying of pipes was commenced in November last, and has been carried out in spite of many difficulties. The total length of pipes laid amounts to 7,700 yds., including 1,702 yds. of 12-in., 1,710 yds. of 8-in. and 4,347 yds. of 4-in. The pipes were laid about 18 ins. below the sidewalk. The connections of the pipes were made by means of india rubber, as in the similar plant in Paris. Valves are provided for shutting off the air from separate lengths of pipe. A trial of the system was made by the engineering authorities of the town and by the Boiler Inspection Association, which showed that there was a loss of 0.11 of an atmosphere in 7½ hours—that is, 0.39 cu. metre per hour kilometre. This loss amounts to 13% on the daily output, the power transmitted being, on an average, 500 HP. The result is said to be regarded as very favorable.

TESTS OF SAMPLES OF PAVING MATERIALS.

Paving material.	No. of sample.	Dimensions of sample.	Weight before testing.	Absorption of Water. Bulk by immersion. Test No. 1.	Bulk by immersion. Test No. 2.	Amount in 24 hours. Test No. 1.	Amount in 24 hours. Test No. 2.	In per cent. of bulk. Test No. 1.	In per cent. of bulk. Test No. 2.	In per cent. of weight. Test No. 1.	In per cent. of weight. Test No. 2.	Penetration by oil in 1 hour. Surface.	Penetration by oil in 1 hour. Depth.	Weight as put in rattler.	Abrasion. Loss of weight in rattler, in ounces, and per cent. of original weight, at end of each hour. First test. 1st hour.	1st hour. %	2d hour.	2d hour. %	3d hour.	3d hour. %	Second test. 4th hour.	4th hour. %	5th hour.	5th hour. %	6th hour.	6th hour. %	Weight after testing.
		ins.	lbs. oz.	cu. ins.	cu. ins.	oz.	oz.	%	%	%	%	ins.	ins.	lbs. oz.	oz.	%	oz.	%	oz	%	oz	%	oz	%	oz.	%	lbs. oz.
"A." Brick from New England.	1	7 7/16 × 2¼ × 3⅜	4 10¼	52.480	51.051	0.083	0.496	0.27	1.68	0.11	0.71	⅝	¼	4 10½	3	4.03	4¼	5.07	4⅞	6.54	5½	7.38	6	8.05	6½	8.74	4	4
	2	7⅝ × 2¼ × 3⅜	4 12	57.037	52.046	0.576	0.247	1.75	0.82	0.76	0.36	⅛	⅛	4 12	3½	4.06	5	6.58	6⅛	8.85	7½	9.87	8½	11.18	9¼	12.18	4	2¾
	3	7⅝ × 2¼ × 3⅜	4 12¼	55.140	51.022	0.657	0.657	2.06	2.23	0.86	0.93	⅝	1/16	4 12¼	3½	4.58	5	6.56	5⅝	7.54	7	9.18	9¼	12.13	10¾	13.44	4	2
	4	7⅝ × 2⅜ × 3⅛	5 0	59.345	55.343	0.496	0.909	1.44	2.84	0.62	1.24	⅛	⅛	5 0	3⅜	4.69	5⅛	6.87	6⅛	8.12	8	10.0	11¼	14.06	13¼	16.56	4	2¾
	5	7 1/16 × 2¼ × 3½	4 12¼	56.891	52.902	1.480	1.729	4.51	5.66	1.94	2.53	9/16	1/16	4 12½	3½	4.57	5¼	6.86	6¼	8.17	7½	9.08	8½	11.11	9½	12.42	4	3
	6	7 1/16 × 2¼ × 3⅛	4 11¾	55.570	51.874	1.310	1.395	4.09	4.66	1.73	2.01	⅝	1/16	4 11¾	3¾	4.95	5¼	6.93	6¼	8.25	7½	9.09	8¼	10.89	9½	12.61	4	2½
	7	7 1/16 × 2¼ × 3⅛	4 11¾	55.915	51.911	0.960	1.239	3.07	3.13	1.34	1.84	⅝	¼	4 9¾	3¾	5.08	5¼	7.12	6¼	8.81	7½	10.17	8½	11.52	9⅝	12 71	4	0⅝
"B." Brick from New York.	1	7⅝ × 2 × 3⅝	4 9¾	54.898	51.048	0.412	0.494	1.03	1.68	0.54	0.71	¾	¼	4 11½	4¼	6.29	5½	7.28	6	7.96	6¾	8.29	6¾	8.94	7¼	9.06	4	4¼
	2	7⅝ × 2 × 3⅝	4 11½	53.153	51.874	0.082	0.410	0.27	1.37	0.18	0.58	⅛	1/16	4 12	2½	3.29	3¼	4.28	4⅝	6.25	5¼	6.91	5¾	7.56	6¼	8.22	4	5¾
	3	7⅝ × 2 × 3⅝	4 12	69.786	58.918	0.496	0.496	1.34	1.46	0.57	0.77	¾	¼	5 7½	4¼	4.87	6	6.87	6¾	7.71	7½	8.57	7¾	8.95	8½	9.71	4	15
"C." Brick from Illinois.	1	7⅝ × 2¼ × 3½	5 7½	63.778	58.918	0.247	0.659	0.68	2.08	0.28	0.85	1	1/16	5 8	7	7.95	10½	11.93	11⅝	13.21	13	14.77	14	15.91	15	17.04	4	9
	2	7¾ × 2⅛ × 3⅜	5 8	62.740	53.756	0.410	0.575	1.16	1.78	0.47	0.74	⅝	1/16	5 7½	5½	6.03	8¾	10.0	9¾	11 17	11	12.61	12	13.75	13½	15.41	4	9¾
	3	7 13/16 × 2⅛ × 3⅜	5 7¾	61.112	55.906	0.413	0.410	1.13	1.27	0.47	0.53	1	1/16	5 7½	6¾	7.14	8¼	9 71	9⅝	11.14	10¾	12.29	11½	13.14	12¾	14.0	4	11¾
	4	7¾ × 2⅜ × 3⅛	5 7½	63.065	56.058	0.413	0.410	1.13	1.27	0.47	0.53	1	1/16	6 12⅜	3	2.77	5¾	4.84	7½	6.91	9¾	8.53	10¾	9.92	12	11.07	6	0½
"D." Brick from W. Virginia.	1	8⅛ × 2⅜ × 4	6 12½	81.705	75.717	1.650	0.741	3.49	1.69	1.52	0.74	¾	1/16	7 0⅝	4¾	4.21	7½	6.65	11	9.76	12¾	11.09	13½	11.97	13¾	13.58	6	1½
	2	8⅝ × 2⅛ × 4	7 4	83.850	74.472	1.230	0.739	2.54	1.72	1.06	0.73	⅝	1/16	6 6⅝	5⅞	5.72	8⅝	8.65	12⅜	12.06	14⅜	14.25	16⅜	16.02	18¾	18.27	5	2⅝
	3	8⅛ × 2⅛ × 4¼	6 11	83.940	69.786	3.290	1.817	3.92	4.01	3.07	2.01	¾	¼	6 1½	2⅜	2.83	4	4.11	4⅝	4.88	5⅝	5.91	6¾	6.43	7¼	7.46	5	10
Oneco Granite Co., Oneco, Conn.	1	8 × 2⅜ × 3½	6 1¼	64.267	61.206	0 247	0.412	0.67	0.47	0.25	0.18	¾	1/16	5 8¾	2½	2.82	4	4.52	4⅝	5.37	5⅝	6.05	6¾	7.06	7	7.91	5	1½
	2	8 × 2⅛ × 3½	5 8½	58.320	55.041	0.329	0.246	0.98	0.78	0.37	0.29	⅝	1/16	5 9	2¾	2.53	3½	3.93	4	4.49	4⅝	5.34	5½	6.18	6	6.74	5	3
Westerly Gran. Co. Westerly R. I.	3	7¾ × 2⅛ × 3¼	5 9	58.270	55.712	0.164	0.165	0.48	0.77	0.18	2.29	¾	¼	5 9	2¾	2.53	3½	3.93	4	4.49	4⅝	5.34	5½	6.18	6	6.74	5	3
	1	8 × 2⅛ × 3½	5 8	67.446	65.593	0.165	0.247	0.42	1.09	0.16	0.41	⅝	½	6 8	1½	1.44	2½	2.04	3	2.88	3½	3.37	4	3.84	4½	4.33	6	3½
	2	8 × 2⅛ × 3½	5 11¼	59.549	58.554	0.000	0.246	0.	0.73	0.	0.28	⅞	⅝	5 11½	1¾	1.91	2½	2.73	3	3.28	3½	3.83	4	4.37	4½	4.92	5	7
												Broken cast iron.		50 0					16	2.0							49	0
												" " "		50 8							8	0.99	8	1.98	8	2.97	49	0

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Middletown & Cincinnati.—M. D. Burke, 41 Pike Building, Cincinnati, chief engineer, writes as follows:

This road is nearly completed from Middletown, O., southeast via Oakland, Union Village and Columbia, to Kings Station, O., 24 miles, and the preliminary surveys have been made for a further extension of 4½ miles to the Baltimore & Ohio Southwestern Ry. About 100 men are now at work, ballasting the roadbed and completing the masonry for the Miami River bridge and the terminals at Middletown. It is expected to have the line opened for traffic by Nov. 1, 1891. The work is quite light; maximum grade 25 ft. per mile and maximum curve 3°. The contractor for the grading, masonry and ballasting is F. B. Douglas, South Lebanon, O., and for the Miami River bridge the Edge Moor Bridge Works

Rockaway Valley.—About $22,000 of the $40,000 required to complete this road from Mendham to Morristown, N. J., 8 miles, have been subscribed, and it is expected that the remainder will be secured in a short time.

Pennsylvania.—Surveys are now in progress for the extension of the Green Spring Valley Branch of this road to Westminster, Md., and Gettysburg, Pa.—The Philadelphia Railroad Committee of Councils is considering the location of the proposed Roxboro R. R., which is projected to run from the Germantown & Chestnut Hill Branch to the Trenton Cut-off, 10 miles. The construction of this branch would necessitate a bridge 564 ft. long and 135 ft. high over the Wissahickon River.—Surveys are reported in progress for an extension of the Bustleton Branch to the Trenton Cut-off.—Surveys are in progress for an extension of the New Cumberland Branch to a point opposite Wellsville, O.

Baltimore & Ohio.—It is reported that a Pittsburg, Pa., syndicate has purchased a large tract of coal land near Suter's Station on this road, and will construct a line of railway through it, connecting with the B. & O. R. R. near Sewickly Station.

Cleveland, Wooster & Western.—This railway from Wooster to Lodi, O., 20 miles, has been completed.

East Barre Branch.—Work has been commenced upon this 1¼-mile Vermont railway. It will be completed this fall.

Lehigh Valley.—The surveys for the line from Thorndale to Marchmont, Pa., have been completed. About 55 miles of single track have been laid on the Buffalo & Geneva R. R. The grading and masonry will be completed this month. It is expected to have a single track completed by Nov. 15.

Projects and Surveys.

Bangor & Aroostook.—The surveys for this Maine

railway are making quite satisfactory progress. Three parties of engineers are now at work. The first party has located the line from Brownsville to Twin Dam. From Twin Dam to Patten the second party has finished the preliminary survey and will soon commence the location. The third party has completed the location of the division from Houlton to Bridgewater, and are now making the preliminary survey from the latter place to Presque Isle.

New Jersey.—A dispatch from New Brunswick, N. J., states that at a recent meeting of the Board of Trade the question of better railway facilities was discussed. It was stated that a railway connecting with one of the trunk lines for New York City could be constructed for $70,000, and it was decided to try and push such a scheme.

Westerly & Jewett City.—According to reports it seems doubtful if a charter can be obtained for this company at the present session of the Connecticut Legislature. This will delay the construction of the proposed road until next season.

Susquehanna & Buffalo.—Chartered in Pennsylvania to build a line of railway from Cook's Run to Trout Run, Clinton Co., Pa., 15 miles. President, John R. T. Ryan, Williamsport Pa.

Chicago, Lake Michigan & Eastern.—Chartered in Michigan to build a railway from St. Joseph to the Indiana line. Among the incorporators are Peter English, of Benton Harbor, Mich., and J. C. Donohue, of St. Joseph.

Eagle's Mere.—Chartered in Pennsylvania to build a railway from a point on the Williamsport & North Branch R. R., near Sonestown, to Eagle's Mere, Pa., 6 miles. President, Andrew J. Maloney, Philadelphia.

Grand Rapids Belt Line.—Organized in Michigan to build a belt line transfer railway around the city of Grand Rapids. Secretary, Z. C. Twing, Grand Rapids.

Washington & Chesapeake Beach.—Chartered in Maryland to build a railway from Jenning's Station, D. C., to Chesapeake Beach, Md., a distance of 30 miles. Surveys have been completed, and the right of way secured. Among the incorporators are Edwin Warfield, of Baltimore, Md., and J. L. Barbour, of Washington, D. C.

SOUTHERN.—Existing Roads.

Murfreesboro.—The grading on this line from Murfreesboro to Conway, 7 miles, has been completed, and tracklaying will begin at once.

Columbus Southern.—At a recent meeting of the directors it was decided to build an extension south into Florida, and to issue bonds for that purpose.

Nashville, Chattanooga & St. Louis.—It is stated tracklaying will soon begin upon the extension of the Tennessee & Coosa R. R. to Guntersville, 6 miles.

Carolina, Cumberland Gap & Chicago.—The *Manufacturers' Record* says:

Contracts for the extension of the Carolina, Cumberland Gap & Chicago R. R. from Edgefield to Abbeville, S. C., have, it is reported, been awarded as follows: From Edgefield to Turkey creek, to J. A. White; Turkey creek to Sheppard's, to W. A. Strom, and from Sheppard's to the Abbeville line, to Duret & Mathis.

Georgia, Carolina & Northern.—It is stated that the grading on the division between Athens and Atlanta, Ga., 60 miles, will be completed in 6 weeks. Tracklaying has been commenced.

Projects and Surveys.

Georgia.—A bill has been introduced into the Georgia State Legislature to charter the Covington & Ocmulgee R. R. Co.

Pensacola & Meridian.—This company will soon begin securing the right of way for its proposed line from Pensacola, Fla., to Meridian, Miss. J. M. Carter, of Pensacola, Fla., is interested.

Tobacco Belt & Florida.—This company has been chartered in Georgia by C. H. Thomas, of Fowlstown, Ga., and others. It proposes to build a railway from the Savannah, Florida & Western R. R. to the Florida line.

NORTHWEST.—Existing Roads.

Kickapoo Valley & Northern.—A press dispatch from Madison, Wis., says:

The Hon. Philip Spooner, who has been in the city for several days has returned to New York, where he has opened an office in the interest of the Kickapoo Valley & Northern R. R. Co. He says that the new road will be pushed to a rapid completion. Work was begun several weeks ago, and 10 miles of the road bed is already prepared and the ties laid. The rails are now being shipped, and as soon as these are laid the work will progress more rapidly, as it will be easier to transport the material. The bridge over the Kickapoo River is already completed, with the exception of laying the rails. It is expected that, if the weather is propitious, by Nov. 15 the road will be completed up to Soldier's Grove, which is only 15 miles from Wilton, the northern terminus. Mr. Spooner intimated that the corporation had an abundance of funds at its disposal, and that all hindrances to the prosecution of the work have been removed. As soon as he returns to New York he will purchase engines, cars and other necessary equipments.

Duluth, Red Wing & Southern.—E. J. Swan, of New York, Financial Agent, is reported as saying that the bonds will be floated without difficulty. The road will extend from Duluth, Minn., to Sioux City, Ia., a distance of 423 miles. The road is now open from Red Wing to Zumbrota, Minn., in Minnesota and will be extended 31 miles to Owattonna at once. A long strip of the road running from Duluth south is nearly completed. The next work will be 25 miles of track on the section being built south from Duluth, extending the line into the pine woods of Northern Wisconsin. After these two small sections are completed the main attention will be paid to the construction of the bridge across the Mississippi at Red Wing and finishing the line between that point and Duluth. Then, without unnecessary delay, the road between Owatonna and Sioux City will be constructed.

Duluth & Winnipeg.—Tracklaying is in progress between Cloquet and Duluth, Minn.

Great Northern.—A press dispatch says:

The latest news indicates that the line known as the Pelican Rapids branch will be built at once, work having commenced. The survey extends from Pelican Rapids via Dugdale to Red Lake Falls, Minn., where the Northern Pacific is building the Duluth & Manitoba from Winnipeg Junction north. Jim Hill commenced work on this Pelican Rapids branch as a bluff, grading the line between Pelican Rapids and Dugdale all but a few miles, paralleling the Northern Pacific on the east. The grade was all ready for rails. Work has now commenced, and the line will run from Pelican Rapids to Red Lake Falls.

Projects and Surveys.

Quincy, Keokuk & Chicago.—Surveys have been resumed on this line from Quincy to Neoto, Ill., 50 miles. Chief Engineer, F. C. Horn, Exchange Building, Chicago.

SOUTHWEST.—Existing Roads.

San Antonio & Aransas Pass.—Work has been resumed on the tracklaying between Cameron and Lott, Tex., and it is expected that the road will be rapidly completed.

Austin & Northwestern.—The city of Austin, Tex., is trying to secure a subscription of $35,000 in aid of the proposed extension to Llano. The city of Llano has already raised $65,000.

Projects and Surveys.

Corsicana & Southeastern.—The money necessary to secure the construction of this Texas railway is being rapidly secured.

ROCKY MT. AND PACIFIC.—Existing Roads.

Southern Pacific.—Surveys are in progress for a railway from Redding, Cal., east to Fall River and Big Valley.—The report that this company had purchased the Astoria & South Coast R. R. is denied.

Denver & Rio Grande.—The Rio Grande & Gunnison R. R. Co. has been chartered to build a railway from Creede Camp to a connection with the Denver & Rio Grande R. R. at Cabello, Colo., a distance of 12 miles. Among the incorporators are: Chas. W. Waterman and Harlan Parmelee.

Denver, Lakewood & Golden.—This line is now practically completed from Denver to Golden, Colo., only a small amount of ballasting remaining to be done. The road is standard gage and laid with steel rails. Surveys have been made for a 7-mile extension to Tyndall, to coal mines, and at Pullman another branch is projected to the summit of Lookout Mt., 8 miles, and ultimately to Idaho Springs and Georgetown. Both steam and electricity will be used.

Great Northern.—The line from Monarch to Barker, Mont., 11¼ miles, has been completed.—Tracklaying on the Pacific extension has reached the summit of the Rocky Mts., 73 miles, west of Kalispell, Mont. About 7,500 men are now at work and it is probable that the line will be completed as far as the Columbia River in Washington this season.

Redondo.—Tracklaying has begun on the extension of this California railway.

Projects and Surveys.

Arizona.—The following railway companies have been charted in Arizona Territory: Big Bug Extension R. R. Co., Midland R. R. of Arizona, Arizona Southern R. R. Co., Bowers Extension R. R. Co., Gerome Extension Co. and Turkey Creek Extension R. R. Co.

Sauk City & Fairhaven.—A project is on foot to build a railway from Sauk City to Fairhaven, Wash. It is stated that the line will be easy to construct and will open up a fine mineral country.

Portland & Southern.—Surveys are reported in progress for the section of this railway between Portland and Marquam, Ore., 35 miles.

Arlington & Monte Cristo.—Surveys have been completed for a railway from Arlington, Wash., to the Monte Cristo mines, a distance of 75 miles. About 20 miles of the right of way have been secured and it is stated that construction will begin within a month. Among those interested are H. G. Bond and Thos. Emory, of Arlington.

Pueblo & Westcliff.—A project is on foot to build a line of rai way from Pueblo to Westcliff, Colo. It is stated that surveys will begin soon and construction commence as soon after they are completed as possible.

Columbia River & Astoria.—W. H. Kennedy, of Portland, Ore., Chief Engineer, writes as follows:

The surveys for this railway, which is projected to run from Astoria to Goble, a distance of 60 miles, were begun early in August. The right of way is now being secured. The maximum grade will be about 10 ft. per mile and the maximum curve 6°. There will be several small drawbridges and a considerable pile trestle. J. H. Smith, of Portland, Ore., is President.

FOREIGN.

Peninsular.—About ½ mile of grading is being completed daily on this railway between San Quintin and Colnett. Surveys are being rapidly pushed along the entire line.

Mexican & International.—It is stated that construction will soon begin on an extension of this railway from Torreon west into the State of Durango, 100 miles. W. T. Robertson is the contractor. The road will penetrate a fine mineral section.

CITY TRANSIT.

Electric Railways.—*Cottage City, Mass.*—A road to Gay Head, 25 miles long, is projected, and a company has been organized with a capital stock of $200,000.

Worcester, Mass.—The Worcester & Shrewsbury Street Ry. Co., North End Street Ry. Co. and Consolidated Street Ry. Co. have applied for permission to adopt electricity, and extend their line.

Revere, Mass.—The Lynn & Boston Ry. Co. has applied for a franchise for an electric road.

Amsterdam, N. Y.—The Amsterdam Street Ry. Co. has been granted authority to extend its line on East Main St.; girder rails and wooden poles will be used.

Buffalo, N. Y.—The Buffalo & Williamsville Electric Ry. Co. has received proposals for the construction of its line. President, R. F. Parsons.

Tonawanda, N. Y.—The Kenmore & Tonawanda Electric Street Ry. Co. has been incorporated by F. M. Vilas, of Buffalo; Martin Reisterer, of Tonawanda, and Harvey W. Putman, of Buffalo.

York, Pa.—The Council has been petitioned to grant an ordinance for an electric railway.

Roanoke, Va.—The street railway company is said to intend adopting electricity upon its 20 miles of line to replace the steam motors and horses.

Columbus, O.—The Columbus Electric Ry. Co. has applied for permission to build a double track road.

Zanesville, O.—The Citizens' Street Ry. Co. proposes to build an electric road 5 miles long. Capital stock, $150,000. President, F. M. Townsend.

Ottawa, Ill.—The electric railway will be extended at a cost of $30,000.

St. Paul, Minn.—The extension of the Selby Ave. cable road is to be converted into an electric line.

Kansas City, Kan.—The Interstate Consolidated Rapid Transit Ry. Co. will, it is said, adopt electricity on all its lines.

Houston, Tex.—The Rapid Transit Ry. Co. has let a contract to Charles H. Davis, of New York, for the construction of its road. He is the contractor for the line now under way at San Antonio. The Houston company intends to build 7 miles by February next.

Sutter Creek, Cal.—Mr. Marsh has completed the survey of the proposed electric road from Ione City, a distance of 12 miles. Surveys have been made both north and south of Sutter Creek.

Santa Cruz, Cal.—Mr. A. P. Hotaling, of San Francisco, has purchased a controlling interest in the Pacific Ave. Street Ry., and proposes to adopt an electric system.

Los Angeles, Cal.—The Los Angeles Cable Ry. Co. will adopt electricity on all its horse lines.

Winnipeg, Man.—Mr. G. H. Campbell has made a proposition to build an electric railway, using storage battery system.

Cable Railways.—*Baltimore, Md.*—The City Passenger Ry. Co. will adopt the cable system on its Blue Line.

San Francisco, Cal.—The Presidio & Ferries Street Ry. Co. will extend its cable lines.

Horse Railways.—*New York, N. Y.*—The North New York Junction Ry. Co. has been organized by B. G. Hughes, O. W. Flannagan, H. A. Gumbleton and B. A. Kirkland, to build a line 2½ miles long on Willis Ave. and 161st St., to Jerome Ave. Capital stock, $250,000. The Sixth Ave. Surface Ry. Co. proposes to extend its lines along Clarkson and Watts St. to the North River ferries.

Allegheny, Pa.—The North End Passenger Ry. Co. has been organized by Francis Tonavee, D. F. Henry and W. F. Lindsay. Capital stock, $200,000.

Dummy Railways.—*Montgomery, Ala.*—Plans and specifications for the new line have been prepared by C. E. Garrett.

Portland, Ore.—The Portland, Chicago & Mt. Scott Ry. Co. is having surveys made for a steam motor line 4½ miles long.

Elevated Railway.—*Chicago, Ill.*—The Chicago & Evanston Elevated Electric Ry. Co. has been incorporated with a capital stock of $2,000,000 by J. L. Cochrane, Alexander Clark and D. H. Lauderbach, who incorporated the Chicago & Evanston electric road about three months ago. At that time the plan was to build an electric road from Evanston to some point near the terminus of the Northside cable, but the company has decided to run its road into the center of the city over an elevated terminal, the tracks to be elevated south of North Ave. The company will attempt to secure a terminus near State and Washington Sts.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Piedmont, W. Va.*—Plans have been prepared for a two-span highway bridge over the Potomac River at this place. The river is about 400 ft. wide.

Parkersburg, W. Va.—The Parkersburg Bridge Co. has been granted the privilege of building a bridge across the Little Kanawha River.

Winona, Minn.—The contract for building the steel highway bridge over the Mississippi River at this point has been let to the Chicago Bridge & Iron Co. A more complete description will be found in our "Engineering News" columns.

HIGHWAYS.

Missouri.—The County Surveyor of Buchanan Co. is locating a new wagon road across the hill near Rushville.

Mr. M. J. Murphy, Street Commissioner of St. Louis, has had surveys made for a military road from Jefferson Barracks to River des Peres. Roadway 50 ft. wide at bottom, side slopes 1 in. in 1 ft., macadam 12 ins. thick, 30 ft. wide, top dressing 3 ins. cement gravel.

A.—From barracks to north boundary of the U. S. reservation, 1,713 ft.:

	$
Grading (cutting and shaping) 27,560 cu. yds., at 20 cts	5,512
Macadam, 7,013x30, 2,104 squares at $4	8,416
Gravel (cement), 2,104-4, 526 squares at $7	3,682
Rolling, 42 days at $10 per day	420
Culverts	500
Total	18,530

B.—From north boundary U. S. reservation to River des Peres, 7,415 ft.:

	$
Grading, cutting and shaping 19,300 cu. yds. at 20 cts	3,860
Macadam, 7,415x30, 2,224 squares at $4 per square	8,896
Gravel, cement, 2,224-4, 556 squares at $7 per square	3,892
Rolling 42 days at $10 per day	420
Culverts	500
Total	17,583
Grand Total	36,118

California.—The owners of the iron mines near Haslett, San Bernardino Co., propose to build a road 20 miles long to haul ore to the railway by steam traction engines.

WATER-WORKS.

NEW ENGLAND.

Brunswick, Me.—M. M. Tidd, Boston, has been making investigations for a new or additional supply.

Farmington, Me.—I. W. Merrill, D. H. Knowlton and others have been appointed as a committee to contract with a company on the franchise plan.

Lisbon Falls, Me.—The *Observer* is in favor of works to be built by a company.

South Berwick, Me.—It is reported that the proposed works will also supply Salmon Falls, N. H. Address J. H. Burleigh.

Portsmouth, N. H.—L. S. Scruton is making surveys for a high service supply, to be gathered from springs and pumped. Probably construction will not be started before spring. Meanwhile, a second driven well is proposed.

West Lebanon, N. H.—A fire district and works are projected.

Bradford, Vt.—Joel Foster, Montpelier, has been investigating works here, as engineer.

North Troy, Vt.—The act enabling the village to issue bonds for works has been accepted and J. W. Currier, G. A. Livingston and three others have been elected commissioners.

White River Junction, Vt.—C. B. Ballard has made a proposition to supply water for fire protection from springs on his farm, through a 2-in. pipe already laid to a point near and about 100 ft. above the village. The supply main is about 7,000 ft. long and leads from a 120,000-gall. reservoir 99 ft. above the proposed distributing reservoir. The village would own the latter reservoir and the distributing system.

Brookfield, Mass.—The sum of $25,000 has been appropriated for improvements at the reservoir, and connecting several springs with the resrvoir.

Kingston, Mass.—A gallery to intercept additional springs will be dug at a cost of about $2,000.

Lee, Mass.—The upper reservoir dam will be raised under the direction of Superintendent J. C. Chaffee.

Whitinsville, Mass.—A. C. Moore, Engineer, Sturbridge, informs us that work has been started on a high service supply. About 8,000 ft. of pipe will be laid.

MIDDLE.

Chester, N. Y.—A supply from Little Long Pond, about 5 miles from and 249 ft. above the village, is proposed.

Clifton Springs, N. Y.—D. A. Lisk, E. D. Copp and others were recently appointed at a citizens' meeting to act with the village board in ascertaining the cost of works.

Lancaster, N. Y.—The water question has been defeated by a vote of 69 to 68.

Mechanicsville, N. Y.—In connection with the new works a reservoir on Plum Creek is proposed. It will be 16,000 ft. from the village, 117 ft. above the river, and will have a capacity of 75,000,000 galls.

Yonkers, N. Y.—Proposals are asked until Oct. 5 for a steel stand-pipe on Nodine Hill. R. Eickemeyer is President and J. A. Lockwood Clerk of the Water Commissioners.

Lancaster, Pa.—S. R. Gray, Providence, R. I., has reported in favor of dividing the city into high and low service, the latter to be supplied from the present reservoir and the former by pumping to a stand-pipe. If the present waste of water is not stopped a 10,000,000-gall. pump will be needed at the main station. Mr. Gray estimates that a 6,000,000-gall. filtering plant could be erected for $68,000.

Mifflintown, Pa.—The Mifflintown Water Co. has been incorporated; capital stock, $30,000.

Patterson, Pa.—The Patterson Water Co. has been incorporated; capital stock, $10,000.

Pottsville, Pa.—The company proposes to lay a line of pipe to St. Clair, 12 ins. in diameter and about two miles long.

SOUTHERN.

Atlanta, Ga.—The contract for 48, 30 and 20-in. pipe in connection with the new Chattahoochee River supply has been let to the Howard-Harrison Iron Co., Bessemer, Ala., for $21.50 per ton, including specials.

Elberton, Ga.—The Senate has passed the water-works and electric lighting bill.

Green Cove Springs, Fla.—A company bearing the name of the place has elected C. M. Merrill, S. F. Hanford and others as directors. A 10-in. well is proposed as a supply.

Orange City, Fla.—The Orange City Water-Works & Irrigation Co. has been incorporated by C. A. Bullen and F. C. Rowell, Eau Claire, Wis. Water will be furnished for irrigating orange groves within two miles from the center of the city. It is expected that construction will be started Oct. 15 and completed March 1 next.

Lafayette, La.—A water-works election is talked of.

Oxford, La.—Water-works, electric lighting and ice plants are proposed by New Orleans parties.

Princeton, Ky.—Works are again talked of.

NORTH CENTRAL.

Ashtabula, O.—It is reported that a 1,000-ft. intake tunnel will be driven beneath the lake.

Toledo, O.—Bids for improvements to the pumping station will soon be asked.

Danville, Ind.—J. B. Homon is chairman of a committee on proposed works, appointed by the Council.

Indianapolis, Ind.—It is probable that a contract will soon be made between the company and the trustees of West Indianapolis for a water supply.

Michigan City, Ind.—An engineer will be employed to assist the City Engineer in locating a new pumping station.

Elk Rapids, Mich.—A vote of 100 to 5 has been taken in favor of works.

Kalamazoo, Mich.—The *Gazette* advocates a supply intake in place of the present one from Howard Lake, about three miles from the city.

NORTHWESTERN.

Tama, Ia.—Works estimated to cost $15,000 are projected by the town.

Excelsior, Minn.—The people have voted for works. The supply will be from Lake Minnetonka and will probably be pumped to a reservoir. Estimated cost, $20,000. Address Mayor W. T. Milnor.

Chadron, Neb.—The system will be changed from pumping to gravity.

SOUTHWESTERN.

Brookfield, Mo.—The contract for prospecting for water has been given by the Water-works Committee to the Cook Well Co., St. Louis.

Eagle Pass, Tex.—Bids will be received until Oct. 20 for material and labor for works, as follows: Two 500,000-gall. Worthington pumps, two 50-HP. steel boilers, feed pump, 16 × 100-ft. stand-pipe, about 5 miles 10 to 2½-in. cast-iron pipe and 25 Ludlow hydrants. C. R. Prouty is Mayor.

Fort Worth, Tex.—Bids will be received until Oct. 19 for the following material and accompanying labor: Two 8,000,000-gall. pumps, 4 boilers, brick chimney, stone pumping station, 12 8-in. artesian wells 1,000 ft. deep, or 8,000,000 galls. flow daily, stone intake well, timber suction crib, 20 × 130-ft. steel stand-pipe, about 9,100 tons 48 to 4-in. cast-iron pipe, with specials, 208 tons pig lead, 15 tons hemp, 488 three-way hydrants, 650 36 to 4-in. double gate valves and boxes, trenching, laying, etc., for about 48 miles of pipe, setting hydrants and valves, and constructing 55,000,000-gall. reservoir, in excavation. Separate bid must be made for the reservoir. J. P. Smith is Mayor, and A. Scoble, Superintendent.

Colfax, Col.—The Trustees have contracted with the Citizens' Water Co., Denver, for a supply.

Colorado Springs, Col.—Water-works extension bonds to the amount of $70,000, bearing 6% interest, have been sold to the Rollins Investment Co., of Boston and Denver, at 101.

PACIFIC.

Roslyn, Wash.—The following is from L. F. McConiche, City Clerk:

Surveys are being made for a supply from the Cle-elum River. A small pump and about 1¼ miles of 6 or 8-in. pipe will be laid. Water will be pumped to the present reservoir.

Whatcom, Wash.—A majority of 27 has decided in favor of a public system.

Colton, Cal.—It is reported that the town talks of building works. The present works are owned by a company.

Santa Rosa, Cal.—The special committee on town works has recommended the employment of an engineer to report on purchasing the company's works, now in operation, or building a gravity or pumping system.

Woodland, Cal.—The people have voted $130,000 of bonds for water-works, sewers and a city hall. The present supply is owned by a company.

Prescott, Ariz.—The Council has received a proposition to lease or sell the city's works, the parties proposing to introduce a new supply from Banning Creek.

CANADA

Brandon, Man.—Bonds for water-works and sewers have been voted.

Winnipeg, Man.—Bids for the construction of the Assiniboine water power works are wanted until Oct. 30 Address the Mayor.

ARTESIAN WELLS.

West Upton, Mass.—A. C. Moore, Engineer of Sturbridge, informs us that wells for an additional supply are being sunk for the water-works.

Oelrichs, S. Dak.—A well is proposed.

Pierre, S. Dak.—Ways and means to sink artesian wells for irrigation in Potter, Sully, Stanley and Brule counties are to be discussed at a convention here Oct. 1.

Helena, Mont.—The Artesian Well Co. has awarded the contract for a 6-in. well, 2,000 ft. deep, cased, for $10,000.

Belton, Tex.—It is reported that a company has been organized to sink a well.

Galveston, Tex.—It is stated that the Galveston Land & Improvement Co. will sink two wells.

Rogers, Tex.—J. N. Bookers and others propose to organize a company and sink a well.

Nolin, Ore.—A move is on foot to prospect for artesian water.

Delano, Cal.—R. C. Cushing, of Omaha, will contract for a well to be sunk about a mile from here.

IRRIGATION.

Colorado.—A state reservoir, formed by a dam 800 ft. long, will be built 13 miles west from Apishapa. Water will be brought to the reservoir from Trujillo Creek through a ditch one mile long.

San Diago, Cal.—The County Board of Supervisors have granted the petition for the formation of the Jamacha Irrigation District, which will joint the city on the east.——The Oceanside Coast Irrigation District is talked of.——The San Diego Flume Co. has issued bonds for $400,000 to be used in extensions and improvements.——J. A. Flint, manager San Diego Water Co., has filed on 7,000 ins. of water from Pine and Cottonwood creeks. A dam and flume will probably be built.

SEWERAGE AND MUNICIPAL.

Sewers.—***New Hampshire.***—Concord. Work is progressing on the South End sewer, which will empty into the Merrimack River.

Massachusetts.—Lynn. Proposals have been received for the construction of the northern main sewer: James Heath, $33,819; F. D. Mayo & Co., $34,181; National Construction Co., $35,643; John Sheehan, $36,002; Metropolitan Construction Co., $37,387. It will be 5,500 ft. long and 45 × 33 ins. to 63 × 22 ins. section.——Newton. Sewers have been ordered in a number of streets; 17 miles are under contract.—Southbridge. The Sewer Committee has recommended the adoption of the plans of Mr. A. C. Moore for the central district sewer.——Nantucket. The Sewerage Committee has engaged Mr. E. H. Bowditch, of Boston, to make surveys and plans for sewers.

Rhode Island.—Woonsocket. A joint plan for a system of sewerage is to be presented by the two engineers who have submitted plans to the Sewer Committee.

New York.—Holley. The sewer question is under consideration by the Sewer Commissioners.——Niagara Falls. The new Board of Sewer Commissioners will proceed to construct a system of sewers, and it is hoped to commence work this fall. Clerk, W. E. Carr. Engineer, W. C. Johnson.

New Jersey.—Orange. The Council has rejected all bids for the outlet sewer, and will receive new bids Oct. 5. This action was necessitated by the refusal of East Orange to unite with the other municipalities in the work. The intention is to build a union outlet to the Passaic River, at Belleville, sufficiently large to accommodate the sewerage of Orange, Montclair and Bloomfield. The latter township has not yet decided to agree to the scheme.——Plainfield. The Mayor has returned the sewer ordinance without approval.

Pennsylvania.—Tunkhannock. A sewerage system is projected.——Punxsutawney. Mr. R. H. Faries, of Williamsport, is laying out a combined system of sewerage. About 2 miles of pipe sewer will be built this fall.

Virginia.—Portsmouth. The Portsmouth Sewage Co. has been incorporated. President, R. C. Marshall; Secretary, R. L. Herbert. It is proposed to build sewers and charge property owners for their use.——Roanoke. Plans for a sewerage system, cheaper than that recommended by Mr. Hering, have been prepared by Mr. Dunlap, City Engineer.

South Carolina.—Columbia. The Lewis & Mercer Construction Co. has made a proposition to build sewers on the franchise plan.

Michigan.—Hancock. A sewerage system, to drain

into Portage Lake, is projected. Plans will be prepared by Mr. C. T. Loweth, of St. Paul, Minn.

California.—Woodland. Plans for the sewerage system have been prepared by A. R. Wilson and T. H. Reed, of Oakland.

Streets.—*Massachusetts.*—Worcester. Street improvements are said to be necessary.—Brockton. Mr. Snow, City Engineer, has made a report on a proposed boulevard.—Lowell. Several street improvements have been petitioned for.

Pennsylvania.—Chester. An ordinance has been passed for paving W. Seventh St.—Lebanon. Mr. W. G. Miller, County Surveyor, writes that one block is being paved with asphalt block by J. C. Wiley, of Lancaster.

Delaware.—Wilmington. The Board of Street and Sewer Commissioners has rejected all the bids for brick paving, the prices of which were given last week, and intends to do the work under its own supervision. There is some dissatisfaction expressed at this plan.

Virginia.—Danville. A paving contract amounting to $16,200 has been awarded Lea & Co.

North Carolina.—Reidsville. A contract for grading, paving and curbing, amounting to $22,600, has been awarded to Lea & Co., of Danville, Va.

Colorado.—Denver. Broadway is to be improved for a distance of 6 miles, and paved with asphalt, brick or stone.

Bonds.—New Whatcom, Wash.; $370,000 for sewers proposed. Macon, Ga.; $210,000 for sewers. Highlands, Col.; $14,000 for sewers; A. R. Smithers, Town Clerk, Oct. 6. Watertown, N. Y.; $20,000 for sewers and streets. Waltham, Mass.; 30-year sewer bonds sold to Boston bankers. Lynn, Mass.; treasurer authorized to issue $35,000 bonds for sewers. Grand Forks, No. Dak.; $50,000 for sewers. Charlotteville, Va.; $7,000 for streets, to be voted on in November. Cleveland, O.; $122,000 for streets, sewers, etc.; awarded to R. L. Day & Co., of Boston, Mass., at $1,435.94 premium. Dayton, O.; $100,000 for streets; C. A. Herbig, City Auditor, Oct. 23. Woodland, Cal.; $45,000 for sewers, $55,000 for water-works, $30,000 for municipal building. Albany, N. Y.; Board of Finance has authorized the issue of Madison Ave. improvement 3½% bonds for $180,000. Buffalo N. Y.; City Council has authorized the issue of 3½% 20 year water bonds for $100,000, to refund same amount on similar bonds due Oct. 1. Redlands, Cal.; $100,000 for drainage ditches. Brandon, Man.; for sewers.

Gas Lighting.—*Wilmington, Del.*—A 5-year contract for street lighting has been awarded to the Wilmington Coal Gas Co. at $16.62 per lamp per annum.

ELECTRICAL.

Electric Light.—*Manchester, N. H.*—The Lighting Committee will receive proposals for the electric lighting of the streets.

Deposit, N. Y.—The Deposit Electric Co. will probably put up arc lights of 1,000 c. p. for street lighting.

West Newton, Pa.—The West Newton Electric Light & Power Co. has a contract for lighting the streets with arc and incandescent lamps.

Olyphant, Pa.—The borough has voted to issue bonds for $10,000 for electric lighting.

Braddock, Pa.—The Citizens' Electric Light Co., has a 3 years contract for 50 arc lights at $50 per lamp per annum.

Wilmington, Del.—The contract for 5 years lighting has been awarded to the Wilmington City Electric Co.

Atlanta, Ga.—The Georgia Electric Light Co. has made a proposition for a 3-years contract for a Thomson-Houston system of lighting; $100 and $40 per annum for arc and incandescent lights.

Chester, S. C.—The National Electric Light Co., of Wisconsin, will put in a plant.

Greenville, O.—The Village Council will receive new bids for electric lighting.

Companies.—Goshen Light & Power Co., Goshen, N. Y.; J. W. Corwin, W. H. Wyker and R. B. Hock; $15,000. West Atlantic Land & Improvement Co., Atlantic City, N. J.; electric light and power; G. H. Perkins, C. L. Maxwell, E. J. Hackney and R. M. Bateman; $100,000. City of Oklohoma Light, Mfg., Canal & Water Power Co., of Jersey City, N. J.; to operate in Oklohoma: W. D. B. Jones and J. H. Bell, Brooklyn, N. Y.; E. B. Newell, New York, and L. L. Clark, Jersey City; $150,000. La Junta Electric Light & Power Co., La Junta, Col.; B. F. Hasking, Frank Finney, and J. B. Sherman; $15,000. Granite Falls Electric Power Co., Snohomish, Wash.; $200,000. Thomson-Houston Electric Light & Power Co., Sharon, Pa.; D. W. Dunn, Allegheny; E. G. Waters and A. W. Williams, Pittsburg; $30,000. Garden City Electric Co., Chicago, Ill.; F. O. Ruloing, E. H. Stephens and J. F. McCraw; $10,000. Field Electric Light Co., Morris, Ill.; Enos Field and Jacob Goriel; $15,000.

CONTRACTING.

Sewers.—*Boston, Mass.*—The Metropolitan Sewerage Commissioners have awarded the contracts for Sections 23 and 40 of the metropolitan sewerage system to R. A. Malone & Son. The prices were given last week.

Summit, N. J.—The following proposals for the construction of 45,000 ft. of 8-in. to 12-in. pipe sewer, and for disposal grounds, were opened by the Township Committee, Sept. 7, and contracts awarded to Condon & Curley and J. W. Hughes, respectively. Mr. C. P. Bassett, of Orange, N. J., is the engineer. The bidders are as follows: *A*, Condon & Curley, Jersey City, N. J.; *B*, J. W. Hughes, Summit, N. J.; *C*, McManus, Newark, N. J.; *D*, Mooney & O'Rourke, Summit, N. J.; *E*, Collier & Sheets, Urichsville, O.; *F*, Ferris & Halliday, Jersey City, N. J.; *G*, Brown & Woodruff, Millburn, N. J.

Sewers.	*A*	*B*	*C*	*D*	*E*	*F*
	$	$	$	$	$	$
12-in. pipe.....14,300 ft.	.74	.85	.93	.90	.90	1.25
12-in. Y's.....470	.80	.90	1.00	.65	.64	1.00
10 in. pipe. 6,600 ft.	.67	.75	.90	.75	.84	1.10
10-in. Y's.....200	.65	.70	1.00	.50	.49	.80
8-in. pipe.....27,400 ft.	.47	.55	.62½	.65	.78	1.00
8-in. Y's.....900	.50	.50	.40	.35	.34	.55
Manholes.....1.500 ft. {	2.50	2.50	2.50	4.00	2.75	5.00
	2.50	3.00	3.00	4.75	3.50	5.00
Flushtanks.....15	70.00	50.00	40.00	60.00	45.00	75.00
Castings.....75,000 lbs.	.03	.03	.02	.02½	.02½	.04
Cast-iron pipe..30 tons.	30.00	35.00	38.00	45.00	45.00	40.00
Concrete...300 cu. yds.	4.00	6.00	4.00	5.00	4.75	6.00
Rock .....300 cu. yds.	2.00	3.50	2.05	2.50	2.50	5.50
Timber..10,000 ft. B. M.	20.00	30.00	20.00	25.00	18.00	30.00
Sheath'g.20,000 ft. B. M.	20.00	25.00	20.00	22.00	20.00	30.00
Excav. below grade.... 300 cu. yds.	1.00	1.10	1.00	1.20	.30	1.00
Total.....	39,086	44,518	46,559	49,275	51,044	70,475

Disposal Grounds.	*B.*		*G.*		*A.*	
	$	$	$	$	$	$
Earth graded.*	.18	900	.22½	1,125	.10	500
Earth hauled..†	.22	2,200	.25	2,500	.15	1,500
Earth hauled.‡	.05	250	.01	50	.20	1.000
Land cleared 10 acres.....	225.00	2,250	125.00	1.250	275.00	2,750
Land finished and graded.§	25.00	250	50.00	500	100.00	1.000
Under drains, 3 ins.....	.17	1,360	.22	1,760	.25	2,000
Under drains, 4 ins.....	.20	1,000	.25	1,250	.25	1,250
Under drains, 6 ins.....	.22	1,100	.31	1,550	.25	1.250
Broken stone in drains.‖.....	3.00	900	2.50	750	3.00	900
Total.....		$10.210		$10,735		$12,150

* 5,000 cu. yds. † 100 ft. 10,000 cu yds. ‡ More than 100 ft., 5,000 cu. yds. § 10 acres. ‖ 300 cu. yds.

Dredging.—The only proposal received Sept. 21 by Lieut.-Col. P. C. Hains, U. S. Engineer Office, Washington, D. C., for dredging in Occoquan River, Va., was from F. L. Somer, Washington, 22 cts. per cu. yd.

Ditch.—The contract for the construction of the Beaver ditch, in Mercer Co., O., has been awarded by the County Commissioners to the J. C. Gibney Co., of Bellaire, O., at $21,445. The engineer is Mr. John Raudabaugh, of Celina, O.

Pipe.—*Findlay, O.*—The Natural Gas Trustees have awarded the contract for 7 miles of 12-in. pipe to the National Tube Works at $1.43 per ft. delivered. The contract will amount to $52,852. The bids were as follows: National Tube Works, 40 lb. pipe, $1.43; Jerecki Mfg. Co., 40 and 49-lb. pipe, $1.50½; American Tube & Iron Co., 40-lb. pipe, $1.48½.

Spokane, Wash.—The City Commissioners have accepted the bid of Holley, Mason, Marks & Co. for furnishing 2,000 tons of cast iron pipe. The first order of about 300 tons to be delivered at $53 per ton. The balance, consisting of 1,700 tons, to be furnished as ordered by the Board of Public Works, at $18.90 per ton at foundry, the freight charges not to exceed the Chattanooga rate.

Street Work.—*Dunkirk, N. Y.*—The lowest proposal for paving, opened Sept. 15, was $1.20 per sq. yd. for macadam, $1.60 per sq. yd. for brick paving with gravel and sand filling, and $2.22 per sq. yd. for brick paving with cement filling or grouting. The prices are exclusive of curbing.

Alliance, O.—The lowest bid for paving Linden Ave. was from W. W. Gibson: Paving, 3,385 cu. yds., 96 cts.; Beloit brick at 92 cts.; curbing, 1,904 lin. ft., 30 cts.; 2,000 ft. socket tile, 12 cts.; 12 Y branches, 50 cts.; excavation, 2,128 cu. yds., 34 cts.; ballast, gravel or sand foundation, 905 cu. yds., 80 cts.; iron gutter, 2,000 lbs. at 2¾ cts.; 4 catchbasins at $10.

Ottawa, Ill.—The contract for street paving has been awarded to the Kimball & Cobb Stone Co., of Chicago, at $1.44 per sq. yd. for small brick. Geo. S. Miller, of Omaha, Neb., was awarded the contract for sewers.

PROPOSALS OPEN.

Bridges.—Two girder bridges, one at Norfolk and one at Brooklyn navy yard. N. H. Farquhar, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., Oct. 10.

Water-Works.—*Eagle Pass, Tex.*—Two Worthington duplex compound pumping engines of 500,000 galls. daily capacity, stand-pipe 16 × 100 ft.; 25 Ludlow fire hydrants; 250 ft. of 10-in. cast iron pipe, 5,800 ft. of 8-in., 550 ft. of 6-in, 8,850 ft. of 4-in., 13,275 ft. of 2½-in. Cheney R. Prouty, Mayor, Oct. 20.

Foundation.—*Philadelphia, Pa.*—Pile and timber foundation for mining casement, etc., on Pea Patch Id. Major C. W. Raymond, U. S. Engineer Office. Oct. 2.

Lock.—Ten gate anchorages for the 800-ft. lock at St. Mary's Falls canal. Col. O. M. Poe, U. S. Engineer Office, Detroit, Mich. Oct. 19.

Ditch.—Deepening and enlarging drainage ditch, 2,000 yds. long, 10,000 cu. yds. excavation. A. L. Slack, clerk of the Police Jury, Tallulah, La. Oct. 1.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., are building consolidation and ten-wheel engines for the Lehigh Valley. The Pittsburg Locomotive Works, of Pittsburg, Pa., are building a compound engine.

Cars.—The Pullman Car Co., of Chicago, Ill., is building 100 ventilated fruit cars for the Illinois Central; they are 35 ft. long over sills, 8 ft. 7 ins. high in the body, and 8 ft. 6 ins. wide over sills; 50,000 lbs. capacity. The Madison Car Works, of Madison, Ill., are building 1,000 box cars for the Chicago, Burlington & Quincy; they will have automatic couplers and air brakes. The Buffalo Car Co., of Buffalo, N. Y., are building 1,000 freight cars for the Delaware, Lackawanna & Western.

The Short Electric Railway Co., of Cleveland, O., has issued a list of 26 roads equipped entirely or in part by this company.

Electric Drills.—The Edison General Electric Co. exhibited at the recent convention of the National Electric Light Association, its electric percussion drill, which will bore 3 ins. per minute in granite, and the diamond prospecting drill for boring 150 ft. The electric drill was illustrated in our issue of July 18.

Tin Plate.—The N. & G. Taylor Co., of Philadelphia, Pa., is said to be manufacturing tinned steel plate.

The Consolidated Car Heating Co., of Albany, N. Y., reports an increasing business, with shops in Canada and the United States running full force. Since June 1 it has received orders for 384 car equipments, 56 locomotive equipments and 6,152 steam couplers. The Vanderbilt and connecting lines are said to be removing the Martin and substituting the Sewall steam coupler on all cars and locomotives.

The Hinson Car Coupler Co., of Chicago, Ill., has secured the services of Mr. Erskine R. Merrell, of Chicago, as General Agent. He was for some years Superintendent of Transportation of the Burton Stock Car Co., and was formerly in railway employ.

Companies.—National Car Wheel Co., of Chicago, Ill.; C. L. Billings, A. E. Peters and Geo. Patton. Lloyds' Sons Steel Co., of Pittsburg, Pa.; John W. Lloyd, A. B. Woods and H. Balkan; $200,000. Genett Air Brake Co., of Chicago, Ill.; L. J. Genett, M. L. Rothschild and I. Neuberger; $800,000. Chicago Electric Wire Co., of Chicago, Ill.; to deal in wires, cables and electrical apparatus; J. W. Dyrenforth, G. N. White and J. N. Hanson; $1,000,000. Aluminum Mining & Smelting Co., of Chicago, Ill.; Freeman Lane, S. R. Oviatt and M. Walker; $1,000,000. State Construction Co., of Chicago, Ill.; H. C. Adcock, N. G. Moore and E. P. Town; $1,000,000. Biddeford Granite Co., of Biddeford, Me.; President, C. E. Goodwin; Manager, Wm. A. Roberts; $200,000.

Metal Market Prices.—*Rails.*—New York: $30.75 to $31; old rails, $21 for iron and $17 for steel. Pittsburg: $30; old rails, $23.50 to $24 for iron and $17 to $17.50 for steel. Chicago: $31.50 to $33; light and street rails, $32.50 to $35; old rails, $23.25 for iron and $15 to $16 for steel.

Track Materials.—New York: steel angle bars, 1.75 to 1.8 cts.; spikes, 2.25 cts.; track bolts, 2.8 to 3 cts., with square and hexagon nuts. Pittsburg: splice bars, 1.75 to 1.85 cts. for iron or steel; iron or steel spikes, 2.15 to 2.2 cts.; iron track bolts, 2.75 cts. with square and 2.85 with hexagon nuts. Chicago: splice bars, 1.85 cts. for iron, 2 cts. for steel; spikes, 2.2 to 2.25 cts.; track bolts, 2.75 to 2.8 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $18. Pittsburg: $14.50 to $17. Chicago: $14 to $16.50

Pipe.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 52½ and 42½ per cent. on black and galvanized butt-welded; 62½ and 50 per cent. on black and galvanized lap-welded. Casing, 55 per cent.

Lead.—New York: 4.5 to 4.55 cts. Chicago: 4.3 to 4.35 cts. St. Louis: 4.3 to 4.35 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.9 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 1.95 to 2.25 cts.; steel plates, 1.95 to 2.15 cts. for tank, 2.25 to 2.6 cts. for shell, 2.4 to 2.6 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 cts.; tees, 2.6 cts.; universal iron mill plates, 2.05 cts.; sheared steel bridge plates, 2.15 to 2.2 cts.; refined bars, 1.8 to 1.85 cts.; steel plates, 2.05 to 2.1 cts. for tank, 2.35 cts. for shell, 2.55 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.05 to 2.1 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.15 to 2.2 cts.; sheared steel plates, 2.2 to 2.25 cts. for steel; steel plates, 2.4 to 2.6 cts. for tank, 2.85 to 3 cts. for shell, 3 to 3.25 cts. for flange; 4.5 to 5.5 cts. for firebox; boiler rivets, 4.25 cts.